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OF

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TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE

TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1889

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(FIFTH OF NEW SERIES)

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BY

SIR JAMES HECTOR, K.C.M.G., M.D., F.R.S.
DIRECTOR

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BOARD OF GOVERNORS.

(EX OFFICIO.)

His Excellency the Governor.

The Hon. the Colonial Secretary.

(NOMINATED.)

The Hon. W. B. D. Mantell, F.G.S.; W. T. L. Travers, F.L.S.; Sir James Hector, K.C.M.G., M.D., F.R.S.; W. M. Maskell, F.R.M.S.; Thomas Mason; the Hon. Robert Pharazyn, M.L.C., F.R.G.S.

(ELECTED.)

1889.—James McKerrow, F.R.A.S.; S. Percy Smith, F.R.G.S.; Alfred de B. Brandon, B.A.

MANAGER: Sir James Hector.

HONORARY TREASURER: W. T. L. Travers, F.L.S.

SECRETARY: R. B. Gore.

ABSTRACTS OF RULES AND STATUTES.

GAZETTED IN THE "NEW ZEALAND GAZETTE," 9TH MARCH, 1868.

SECTION I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

2. Any Society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the members of the said Society shall at any time become less than twenty-five, or the amount of money annually subscribed by such members shall at any time be less than £50.

3. The by-laws of every Society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of the annual revenue in or towards the formation or support of some local public museum or library, or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and Library of the New Zealand Institute.

4. Any Society incorporated as aforesaid, which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid, shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any Society for the time being incorporated with the Institute shall be deemed to be communications to the Institute, and may then be published as Proceedings or Transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications:—

Regulations regarding Publications.

(*a*.) The publications of the Institute shall consist of a current abstract of the proceedings of the Societies for the time being incorporated with the Institute, to be intituled "Proceedings of the New Zealand Institute," and of transactions, comprising papers read before the incorporated Societies (subject, however, to selection as hereinafter mentioned), to be intituled "Transactions of the New Zealand Institute."

(*b*.) The Institute shall have power to reject any papers read before any of the incorporated Societies.

(*c*.) Papers so rejected will be returned to the Society in which they were read.

(*d*.) A proportional contribution may be required from each Society towards the cost of publishing the Proceedings and Transactions of the Institute.

(*e*.) Each incorporated Society will be entitled to receive a *proportional* number of copies of the Proceedings and Transactions of the Institute, to be from time to time fixed by the Board of Governors.

(*f*.) Extra copies will be issued to any of the members of incorporated Societies at the cost-price of publication.

6. All property accumulated by or with funds derived from incorporated Societies, and placed in the charge of the Institute, shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all Societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the by-laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any Society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the Society.

Section II.

For the Management of the Property of the Institute.

9. All donations by Societies, public departments, or private individuals to the Museum of the Institute shall be acknowledged by a printed form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue.

11. Books relating to natural science may be deposited in the Library of the Institute, subject to the following conditions:—

(*a.*) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(*b.*) Any funds especially expended on binding and preserving such deposited books at the request of the depositor shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(*c.*) No books deposited in the Library of the Institute shall be removed for temporary use except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the Library of the Institute shall be duly entered in a catalogue, which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and Library subject to by-laws to be framed by the Board.

Section III.

The Laboratory shall for the time being be and remain under the exclusive management of the Manager of the Institute.

Section IV.

Of Date 23rd September, 1870

Honorary Members.

Whereas the rules of the Societies incorporated under the New Zealand Institute Act provide for the election of Honorary Members of such Societies, but inasmuch as such Honorary Members would not thereby become members of the New Zealand Institute, and whereas it is expedient to make provision for the election of Honorary Members of the New Zealand Institute, it is hereby declared,—

1. Each incorporated Society may in the month of November next nominate for election as Honorary Members of the New Zealand Institute three persons, and in the month of November in each succeeding year one person, not residing in the colony.
2. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as Honorary Members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.
3. From the persons so nominated the Governors may select in the first year not more than nine, and in each succeeding year not more than three, who shall from thenceforth be Honorary Members of the New Zealand Institute, provided that the total number of Honorary Members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION.
WELLINGTON PHILOSOPHICAL SOCIETY	10th June, 1868.
AUCKLAND INSTITUTE	10th June, 1868.
PHILOSOPHICAL INSTITUTE OF CANTERBURY	22nd Oct., 1868.
OTAGO INSTITUTE	18th Oct., 1869.
WESTLAND INSTITUTE	21st Dec., 1874.
HAWKE'S BAY PHILOSOPHICAL INSTITUTE	31st Mar., 1875.
SOUTHLAND INSTITUTE	21st July, 1880.
NELSON PHILOSOPHICAL SOCIETY	20th Dec., 1883.

OFFICERS OF INCORPORATED SOCIETIES, AND EXTRACTS FROM THE RULES.

WELLINGTON PHILOSOPHICAL SOCIETY.

OFFICE-BEARERS FOR 1890.—*President* — Charles Hulke, F.C.S.; *Vice-presidents* — A. McKay, F.G.S., E. Tregear, F.R.G.S.; *Council*—W. T. L. Travers, F.L.S., H. P. Higginson, M.Inst.C.E., Hon. R. Pharazyn, M.L.C., F.R.G.S., W. M. Maskell, F.R.M.S., Sir James Hector, K.C.M.G., M.D., F.R.S., A. de B. Brandon, B.A., E. D. Bell; *Secretary and Treasurer*—R. B. Gore; *Auditor*—T. King.

Extracts from the Rules of the Wellington Philosophical Society.

5. Every member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual contribution shall be due on the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition for life of the ordinary annual payment.

14. The time and place of the general meetings of members of the Society shall be fixed by the Council and duly announced by the Secretary.

AUCKLAND INSTITUTE.

OFFICE-BEARERS FOR 1890. — *President* — J. Stewart, C.E.; *Vice-presidents* — Josiah Martin, F.G.S.; S. Percy Smith, F.R.G.S.; *Council*—W. Berry, Professor F. D. Brown, C. Cooper, T. Humphries, E. A. Mackechnie, T. Peacock, M.H.R., J. A. Pond, A. G. Purchas, M.R.C.S., J. B. Russell, Professor A. P. Thomas, F.L.S., Rev. W. Tebbs; *Trustees*—E. A. Mackechnie, T. Peacock, M.H.R., S. P. Smith, F.R.G.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

Extracts from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute shall be proposed in writing by two members, and shall be balloted for at the next meeting of the Council.

4. New members on election to pay one guinea entrance-fee, in addition to the annual subscription of one guinea, the annual subscription being payable in advance on the first day of April for the then current year.

5. Members may at any time become life-members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual general meeting of the Society on the third Monday of February in each year. Ordinary business meetings are called by the Council from time to time.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Office-bearers for 1890.—*President*—S. Hurst-Seager, A.R.I.B.A.; *Vice-presidents*—H. R. Webb, F.R.M.S., J. T. Meeson, B.A.; *Treasurer*—J. T. Meeson, B.A.; *Secretary*—R. M. Laing, M.A., B.Sc.; *Council*—Professor F. W. Hutton, Dr. Symes, T. W. Naylor Beckett, F.L.S., B. Bull, R. W. Fereday, F.E.S.

Extracts from the Rules of the Philosophical Institute of Canterbury.

21. The ordinary meetings of the Institute shall be held on the first Thursday of each month during the months from March to November inclusive.

35. Members of the Institute shall pay one guinea annually as a subscription to the funds of the Institute. The subscription shall be due on the first of November in every year.

37. Members may compound for all annual subscriptions of the current and future years by paying ten guineas.

OTAGO INSTITUTE.

Office-bearers for 1890.—*President*—Dr. Belcher; *Vice-presidents*—Dr. de Zouche, Dr. Hocken; *Council*—— Chapman, — Wilson, D. Petrie, Professor Scott, Professor Parker, C. W. Adams, G. M. Thomson; *Secretary*—Professor Gibbons; *Treasurer*—E. Melland; *Auditor*—D. Brent.

Extracts from the Constitution and Rules of the Otago Institute.

2. Any person desiring to join the Society may be elected by ballot, on being proposed in writing at any meeting of the Council or Society by two members, and on payment of the annual subscription of one guinea for the year then current.

5. Members may at any time become life-members by one payment of ten pounds and ten shillings in lieu of future annual subscriptions.

8. An annual general meeting of the members of the Society shall be held in January in each year, at which meeting not less than ten

members must be present, otherwise the meeting shall be adjourned by the members present from time to time until the requisite number of members is present.

(5.) The session of the Otago Institute shall be during the winter months, from May to October, both inclusive.

WESTLAND INSTITUTE.

OFFICE-BEARERS FOR 1889.—*President*—John Nicholson; *Vice-president*—Arthur H. King: *Treasurer*—J. W. Souter; *Committee*—J. N. Smythe, R. Cross, M. L. Moss, E. B. Sammons, Captain Bignell, J. P. Will, B. Durbridge, F. Eckman, — Scanlan, W. L. Fowler, C. E. Holmes, R. Hilldrup; *Secretary*—Henry Weston.

Extracts from the Rules of the Westland Institute.

3. The Institute shall consist (1) of life-members—*i.e.*, persons who have at any one time made a donation to the Institute of ten pounds ten shillings or upwards, or persons who, in reward of special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting; (2) of members who pay two pounds two shillings each year; (3) of members paying smaller sums, not less than ten shillings.

5. The Institute shall hold a half-yearly meeting on the third Monday in the months of December and June.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

OFFICE-BEARERS FOR 1890.—*President*—Dr. Spencer; *Vice-President*—H. Hill; *Council*—Dr. Moore, A. V. McDonald, J. S. Large, J. T. Carr, W. J. Birch, R. Lamb; *Secretary and Curator*—A. Hamilton; *Treasurer*—R. C. Harding; *Auditor*—T. K. Newton.

Extracts from the Rules of the Hawke's Bay Philosophical Institute.

3. The annual subscription for each member shall be one guinea, payable in advance on the first day of January in every year.

4. Members may at any time become life-members by one payment of ten pounds ten shillings in lieu of future annual subscriptions.

(4.) The session of the Hawke's Bay Philosophical Institute shall be during the winter months from May to October, both inclusive; and general meetings shall be held on the second Monday in each of those six months, at 8 p.m.

SOUTHLAND INSTITUTE.

OFFICE-BEARERS FOR 1887.—*President*—Ven. Archdeacon Stocker; *Vice-president*—A. Highton, B.A.; *Council*—— Bailey, — McLean, C. Tanner, Dr. Galbraith, and Dr. Closs; *Treasurer*—E. Robertson; *Secretary*—E. Webber.

NELSON PHILOSOPHICAL SOCIETY.

Office-bearers for 1890.—*President*—Bishop of Nelson; *Vice-presidents*—Dr. Boor and A. S. Atkinson; *Secretary*—Dr. Coleman; *Treasurer*—Dr. Hudson; *Council*—Dr. Mackie, J. Holloway, Dr. Cressey, Rev. A. R. Watson, — Joynt; *Curator*—R. T. Kingsley.

Extracts from the Rules of the Nelson Philosophical Society.

4. That members shall be elected by ballot.

6. That the annual subscription shall be one guinea.

7. That the sum of ten guineas may be paid in composition of the annual subscription.

16. That the meetings be held monthly.

23. The papers read before the Society shall be immediately delivered to the Secretary.

TRANSACTIONS.

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE, 1889.

I.—MISCELLANEOUS.

Art. I.—*The Middle Voice in Latin.*

By Henry Belcher, Fellow of King's College, London, Rector of the High School of Otago.

[*Read before the Otago Institute, 14th June, 1887.*]

"All verbs which refer primarily to a physical process, and do not merely state the fact that such-and-such an action is going on, are either deponent throughout, or deponents in the future tense.

"In other words, if the primary reference of a verb is to any physical action, functional or organic, that verb has the inflexions of the middle voice either in all its tenses or in one—the future."*

The article (cccii.) contains Dr. Rutherford's proof of the proposition advanced, and the proof appears to me conclusive.

The pre-eminence of the future middle forms in Greek has long been a difficulty with Greek students. There is no obvious reason why future-tense forms should predominate as reflexive or middle. If there is any subtle significance attaching to future actions so that a reflexive force should be felt to be inherent in them, and that such force should be expressed by inflexions, the significance is so subtle that it evades discovery. In Latin as in French and Spanish the future is built up of auxiliaries, while in O. English at the state of high inflexional condition there was no future tense.

The reflexive pronoun and the Greek future suffix have the letter s common to both. This significant s is a remarkable fragment of language. As regards the reflexive pronoun there seems to be evidence that *se*, which within the literary period has represented the third grammatical person, had at a

* Rutherford: New Phrynichus, p. 383.

remoter period represented the second and first grammatical persons reflexively.

At the time written language brings *se* to notice it is in a worn-out condition. It retains no mark of gender or of number. Even the genitive case has vanished. In actual use the same inflexions of SE are, according to the context, considered either as singular or plural. It is highly probable that in its earlier condition the reflexive *se* was fully inflected for all relationships customarily represented by inflexion. Logically there is necessity for reflexives in all three persons. And if there were some primary sound *sa* there can be no *a priori* reason why number, gender, case, and person should not have been represented by developments of this radical. At any rate it is now admitted as a working hypothesis that *verto-r* is the same as *verto-se*, and on this hypothesis, as *verto se* means "I turn myself," *se* here represents the first person.

On the general question that the reflexive verb precedes the passive, that in the growth of verbal forms the middle or reflexive verb is historically antecedent to the passive forms, there has been since Bopp's time substantial agreement. Bopp (ii. 648) enunciates his view briefly thus: *Ma-mi, sa-si, ta-ti,* are suffixes naturally formed by reduplication. If, then, *ma* signifies *me*, *ma-mi* signifies myself. By parity of formation, *sa-si, ta-ti,* mean thyself, himself. Hence arise the suffixes of the present indicative reflexive of the Greek verb. *Ma-mi* falls away into -*μαι*, *sa-si* into -*σαι*, *ta-ti* into -*ται*.

Bopp points out that in Old Slavonic the Accusative of the reflexive pronoun is added to the transitive verb to give it a Reflexive or passive significance. He illustrates from Lithuanian, which attaches the consonant -*s* without vowel mediation to the active voice to form the reflexive verb; under certain conditions also it prefixes the reflexive pronoun with the same result.

In 1846 Key advanced this view of the Latin middle voice, as being not an application of the passive voice, but as being the actual forerunner of the passive voice. Key said (Lat. Gr., 2nd edit., p. 59),—

"In Latin a reflective suffix is added to a transitive verb, so as to give it the reflective sense.

"A reflective verb thus denotes an action upon oneself, and in Latin is conjugated in the imperfect tenses with a suffix -*s* or -*v*. An intransitive verb is generally in meaning reflective: as cŭr—*i.e., put oneself in a certain rapid motion;* ambŭla—*i.e., put oneself in a certain moderate motion;* but, as the object in these cases cannot easily be mistaken, no reflective pronoun or suffix is added.

"When the source of an action (*i.e.*, the nominative) is not known, or it is thought not desirable to mention it, it is com-

mon to say that the action proceeds of the object itself: thus *vertitur*, literally *he turns himself*, is often used for *he is turned*. A reflective so used is called a *passive*.

"This passive use of a verb with a reflective suffix is more common than the proper reflective use.

"Hence passive verbs can only be formed from transitives."

In a foot-note Key calls attention to the parallel use in modern European languages.

In Metaphysics, the causes assignable for this priority of use seem to be logically adequate. It is reason to suppose that, after the primary notion of the verb as active has developed itself—that is, as soon as the subjective notion of the verb as expressing the agent is fully established—the next step in thought and in expression will be towards the object. As the object grows out of the subject in conscious thought, so the object grows out of the subject in expression. Between the myself and the not-myself there is a whole mass of actions, coincidences, and sequences belonging to the mutual relationships of the myself and the not-myself. This condition of consciousness represents a stage of experience, ultimately expressed with relative clearness by development of the appropriate suffixes.

At this medial stage, the union of the subject-object being substantially prominent in consciousness, there is a corresponding mode of expression, the medial or reflexive suffix.

The final stage in the growth of the verb is the establishment of difference between subject and object, as when in predication the subject of the statement is also the object of the action indicated in the statement. Hence arises the passive voice.

This development is not attended by amplification of the verbal suffix; for there is a law of parsimony. Suffixes cannot be invented, and language adapts old forms for new conditions. Accordingly the medial verbal suffix is charged with this new meaning, and, as the phenomena of experience increase, the passive voice is more frequently used than the middle voice, and in Latin partially displaces it.

That the final *r* of the Latin passive is the *s* of the reflexive pronominal stem was observed seventy years ago. "It was in the Annals of Oriental Literature," says Bopp, "that it was observed that the passive *r* might owe its origin to the reflexive*" (cf. Serial for 1820, p. 62).

Key (Lat. Gr., § 405) arrives at the conclusion that—

"The verb has two forms or voices, the simple voice (commonly called the active), which does not take the reflective suffix; the reflective voice (commonly called the passive), which does take it."

Note.—Rhotacism is the tendency to replace *s* by *r*. The following common instances illustrate how *s* between two vowels gives way to *r*. Ara (asa, the base of the altare, or high thing raised on it); heri, hesi, hesternus, yesterday; dius, diurnus; lases, lares, larva; porro, πρόσω; ausosa, aurora; virus, visas; weorer, worse; Snusa, nurus, snura (O.H.G.); gloria, closia, κλέος; ur-o, us-si; carmen, casmen; terra, ter-sa. Festus and Varro use foedesum, plusima, moliosem, maiosibus, arbosem. In a decree against Timotheus given in Maittaire 383–384, *r* is used instead of *s* throughout. The decree is Dorian. Cf. also Curtius, Gr. Etym. p. 396 (2nd edition); Ahrens, ii. 71; Peile, p. 346. Corssen (Formenlehre, 1866), p. 228, notices that in the perf. subjunctive active, suffix -rim, -rio, -rit, &c., has displaced -sim, -sis, -sit, extant in older forms; auxim, faxim, &c. Key, Lat. Gr.: loc. cit. Accordingly verto-se becomes vertor-e, and the vowel *e* being unemphatic drops away.

Roby (§ 548) says of the Latin verb,—

"There are two voices, the active and the passive (sometimes called reflexive or middle).

"Some verbs have both voices. Some have only the active; others, called also deponents, have only the passive, but with the signification (apparently) of the active."

This very guarded statement of the grammarian is to be noted. In § 734 Roby has made a list of the deponent verbs, and adds, "Sometimes they, especially in the past participle, are used in a passive as well as in an active sense." These words are appended at the conclusion of this article.

Madvig (§ 222, obs. 3) as usual has hit the right nail on the head:—

"As regards the passive, it is to be noticed that where in German a reflexive verb is used the Latin passive stands thus: *Commendari*, to recommend oneself; *congregari*, to assemble themselves; *contrahi*, to contract itself; *delectari*, to delight oneself; *effundi*, to pour out; *diffundi*, to spread abroad; *lavari*, to wash oneself; *moveri*, to move; *mutari*, to change; *porrigi*, to reach.

"Sometimes, too, Latin has a peculiar signification which a more literal translation would not adequately express: *tondeor*, I get shaved; *cogor*, I see myself obliged, &c."

In this passage the position of the Latin middle voice is to some extent indicated, and certain illustrations recorded. The philology of the day accepts under some reserve the Latin middle voice. Sayce seems to adopt it (Introduction to the Science of Language, i., p. 178): "The Latin *amamini* is the plural masculine of the old middle participle." Morris (Historical Outlines, § 11) has pointed out a similar phenomenon in the Scandinavian languages: "The reflexive pro-

noun *sik* (O.N.), *sig* (Swed. and Dan.), Lat. *se*, coalesces with verbs and forms a reflexive suffix: as O.N. *at falla*, fall down, *sik* = self, produce the reflexive or middle verb *at fallask*.

"*Sk* is still further worn down to *st*, and when added to the verb renders it passive, as O.N. *at kalla*, to call, *at kallast* = to be called."

In our own language there are a few traces of the same formation: cf. bask = warm oneself in the sun; busk = fix oneself up (with clothing). Cf. Cleasby and Vigfusson, Icelandic Dict., s.v.; and Skeat's Appendix.

Personally, I look to French for evidence that in the streets and in the camp the so-called passive was commonly used as a reflexive. Otherwise I cannot yet see how the reflexive verb in French comes to replace and be used as passive. Having counted in ten pages of Béroalde, and in Brantôme, all the verbs, I find the reflexive forms predominate, while in the majority of examined cases the passive meaning is clear. It seems that, in the general ruin of inflexions during the transition of Provincial Latin into French, the few reflexive tenses or inflections existing in Latin were overwhelmed. "Le deponent n'a eu aucune action sur notre langue, et n'y a laissé aucune trace. Depuis longtemps il avait disparu dans le latin populaire, ou, pour mieux parler, il y était passé à l'actif. Dans les formules et dans les chartes on trouve sans cesse des formes telles que *precare*, *proficiscere*, *largire*, &c." — Léon Gautier in notes to his edition of La Chanson de Roland.

The passive or reflective voice in Latin had three inflected tenses: all other tenses were built up of the auxiliary verb. In the reconstruction of the Provincial language *morior* is *je me meurs*. The ancient pronominal suffixes are now expressed analytically: the so-called passive form has given rise to a reflexive statement. How is so remarkable a change possible unless in common speech the inflections called passive were indifferently used both as reflexive and as passive?

If the fluctuations of other languages are so great that even in the common run of conversation the same verb often slides from one class into another class of usage, is it reason to suppose that this observed flexibility of speech is wanting to a language so widely spread and so long used as Latin?

It seems, to me, then, that an exact study of the French language as compared w th the Latin of Plautus would indicate very clearly that our estimate of the Latin passive has been much exaggerated, our translations of the past participle forced and unnatural, and that, in a desire to be consistent (in a world where consistency of action, conduct, and speech is unknown), we have done violence to the thoughts and expressions of the authors we have studied.

The following passages and words are now submitted in illustration of the above remarks. Some of the words have been already noted in dictionaries as reflexive; others are noted as constructed with the "Greek accusative." Perhaps the time may be approaching for the disappearance of this ponderous jest from our grammars. For the translations appended and not marked with the name of the translator the present writer is responsible.

Adservari. Pl., Amph. 344.

Merc. Ego tibi istam, hodie, sceleste comprimam linguam.
Sos. Haud potes. Bene pudiceque *adservatur*.

It keeps a good and modest watch over itself. *se maintenir.*

Adsuefieri. C., G. vi. 24.

Paullatim *adsuefacti* superari, multisque victi proeliis.

They gradually accustom themselves to defeat.

Adsuesci. Liv. ii. 1.

Caritas ipsius soli, cui longo tempore *adsuescitur*.

The attachment to the actual soil, to which in course of time one grows accustomed.

Agi. Caes., G. v. 50.

Cum simulatione timoris *agi* jubet.

He bids them behave as if afraid. Cf. L. and S., § 11, s.v. agere se.

Tac., Ann. ii. 62.

Dum ea aestas Germanico plures per provincias *transigitur*.

While for Germanicus the summer passes away in a tour through numerous provinces.

Here Church and Brodribb, following the traditional lines, call *Germanico* a dative of the agent after the passive voice.

Tac., Ann. ii. 65.

Posse de controversiis conloquio *transigi*.

They might by an interview settle their disputes.

Amiciri.

Cf. Lewis and Short, s.v., who admit that *amiciri*=amicire se, and illustrate by numerous examples.

Angi.

See Lewis and Short, s.v., who give as a meaning of *angi* "to feel or suffer pain," and illustrate.

Aperiri. Pl., Curcul.

Nunquam ullum verbum muttit. Quom *aperitur* tacet.

It mutters never a word. When it opens it keeps its counsel.

Virg., Aen. iii. 275.

Et formidatus nautis *aperitur* Apollo.
"Comes into sight" (Conington).

Armari. Aen. vii. 506.

Hic torre *armatus* obusto.
He, arming himself with a charred brand.
Cf. also C., G. iv. 32. Cæsar bids the remaining cohorts to arm themselves (reliquas cohortes *armari*).
C., B.C. i. 28. Milites *armari* jubet.
Liv., iv. 33, 6. Utraque acies *armatur* igni.

Obviously here the troops are bidden to arm themselves, or actually arm themselves with torches.

Cingi. Liv., v. 46.

Gabino cinctu *cinctus*.
Having girded himself in the Gabine method.

Virg., G. iii. 46.

Accingar dicere pugnas Cæsaris.
I will gird myself to sing of Cæsar's battles. (Cf. also Æn. iv. 493.)

Compare with this a passage in which *se* is used with the active voice.

Virg., Aen. i. 210.

Illi se praedae *accingunt*.
Cf. also Liv. i. 47: Quin *accingeris?* And Virg., Aen. vii. 640; Ter., Ph. 318.

Plaut., B. 429.

Cincticulo *praecinctus* in sella aput magistrum sedisse.
(L. and S. read here adsidere.)

Praecinctus may mean "having tucked up into a knot in front." The præcincture is a way of tucking up a flowing gown into a girdle so as to have the knot in front. (Cf. Hottenroth: Le Costume, pl. 47, 11.)

Ovid., Met. i. 699.

Pan videt hanc, pinuque caput *praecinctus* acuta.
Having crowned his head with a coronal of pine-needles.

Hor., Sat. ii. 8, 70.

Praecincti recte pueri.
There are other instances in Lewis and Short, s.v.

-clinari. Cæs., G. vi. 27.

His sunt arbores pro cubilibus: ad eas *se applicant*, atque ita paullum modo *reclinatae* quietem capiunt. . . . . Huc quum se consuetudine *reclinaverunt*, &c.

Here we have three reflexives under two different forms.

Congregari. Tac., Ann. i. 13.

Ut non egredi, *congregari* inter se, vix tutari signa possent. The *inter se* seems to be pleonastic.

Cic., De Senect. 3.

Cf. also: Pares cum paribus facillime *congregantur*.

Like with like most easily associate.

This verb is admitted by Madvig (§ 222) as a reflexive verb.

Consuli. Liv., ii. 29, 5.

Senatus, tumultuose vocatus, tumultuosius *consulitur*.

The Senate was summoned in confusion, and in greater confusion deliberates.

This seems to be an occasional use of *consuli* in this context.

Cf. Liv. xxii. 60, 2.

Copulari. Pl., Aul. 116.

Adsistunt, consistunt, *copulantur* dexteras.

Wagner in loco says this verb is used as deponent only in this place; but there seems to be a parallel passage in Martial xii. 43, 8: Quo symplegmate quinque *copulentur* (sensu obscaeno).

Dari. Liv., v. 21, 24.

Dedi inde inermes coepti.

Whereupon the unarmed folk began to yield (Phil. Holland).

Liv., v. 48, 7.

Vel *dedi* vel redimi se quacunque pactione possent jussit.

He bade them either surrender or ransom themselves on any condition possible.

Notice the reflective pronoun here redundant; *redimi* means "get themselves ransomed."

Liv., iii. 35, 5.

Collegae quoque qui unice illi *dediti* fuerant ad id tempus.

Liv., ix. 8, 6.

Dedamur per fetiales nudi vinctique.

Liv., ix. 11, 10.

Ego vero istos quos *dedi* simulatis, nec accipio nec *dedi* arbitror.

Liv., i. 32 (an old formula).

Si injuste impieque illos homines, illasque res, *dedier* mihi exposco.

There may be zeugma here. Seeley, loc. cit., makes no comment.

Caes., G. ii. 15, 2.

The active verb with *se* is used in same sense. Ambiani *se* suaque omnia sine mora *dediderunt*.

Pl., A.

Deduntque se, divina humanaque omnia, urbem et liberos in ditionem.

This construction is common in Cæsar.

Lucr., iii. 814.

Cur igitur mirumst, animus si cetera perdit,
Praeterquam quibus est in rebus *deditus* ipse?

Why therefore should we wonder if our mind loses cognizance of other matters, especially in the case of subjects *to which it has devoted itself?* (Monro.)

Tac., Ann. i. 59.

Fama *dediti* benigneque excepti Segestis vulgata.

The report of Segestes' surrender of himself, and of his kindly welcome, was noised abroad.

Tac., Ann. i. 17.

Quae [sc. cohortes], post sedecim annos, penatibus suis *reddantur*.

And they, after sixteen years' service, return to their own homes.

Tac., Ann. i. 30.

Quisque hibernis *redderentur*.

Cf. also Tac., Agric. 28.

Caes., G. i. 39.

Abditi in tabernaculis . . *querebantur* . . . *miserabantur*. (All reflexive verbs.)

They hid themselves in their quarters, and wailed and moaned over their fate (because their campaigning seemed to threaten hard fighting).

Densari. Denseri. Virg., Aen. vii. 794.

Insequitur nimbus peditum, clypeataque totis
Agmina *densentur* campis, Argivaque pubes.

Cf. also Hor., Od. i. 28, 19: *densentur*, "crowd together;" and Lucr., i. 395.

Dominari. Ovid, Met. i. 77.

Et quod *dominari* in cetera posset.

This word is mentioned as it is usually entered in the list of deponents. There is at least one good instance in the passive voice:—

Cic., Off. i. 39.

O domus antiqua, heu, quam dispari *dominare* domino.

Erigi. Ovid, Met. i. 744.

Officioque pedum nymphe contenta duorum,
Erigitur.

The maid stretches herself, and by the service of her two feet stands erect. (*Contenta* is here from *contendor*, and is reflexive. *Contineri* is reflexive in Liv., xxii. 55, 6.)

Yet cf. Cæs., G. vi. 27: *erigere* sese.

Exerceri. Virg., Aen. vii. 163.

Exercentur equis, domitantque in pulvere currus.

So Virg., Georg. iv. 159: *exercentur* agris.

Exercentur equis. *Exercentur* agris. Notice Conington's hesitation in the two passages quoted: *equis* he says is the ablative of the instrument, while *agris* he thinks is locative. As if the riders are exercised by the horses! (which, indeed, in a certain sense may be true).

Yet note that *exercere se* is a common locution: Cic., De Senect. c. 14.

-fendo. Tac., Ann. ii. 55.

Offensus urbi propria quoque ira.

Infensus is used actively, e.g., *infestis* animis, equum *infestus* admisit, &c.

Infensus is passive in: *Infensum* omnem agrum reddidit—he made the whole Roman territory *so unsafe.*

This usage is noticed in all dictt. s.v.

Ferri. Lucr., i. 290.

Sic igitur debent venti quoque *ferri.*

In this way then must the blasts of wind move on. (Monro.) That is, "bear themselves along."

Liv., vi. 30, 4.

Dum praesidio ut essent citati *feruntur.*

Liv., ix. 13, 2.

In hostem *feruntur.*

Caes., G. ii. 24.

Ferebantur.

Virg., Aen. vii. 673.

Densa inter tela *feruntur.*

Liv., v. 26, 7.

Castra sua quae propiora erant *praelati* urbem peterent.

Liv., vi. 29, 3.

Praeter castra etiam suo pavore *praelati.*

Liv. vii. 24, 8.

Praeter castra etiam fuga *praelati.*

So also Liv., ii. 14, 7; Liv., xxxviii. 27, 2; et ubique.

Liv., v. 13, 12.

Nec ita multo post jam palantes veluti forte *oblati* populatores Capenatis agri reliquias pugnae absumpsere.

And not long after the foragers, that wasted the lands of the Capenates, as they ranged abroad here and there, encountered the residue and remnant of this battail. (Phil. Holland.)

Liv., ix. 31, 7.

Transfugae agrestes . . . *oblati*.

Liv., ii. 14, 8.

Inermes et fortuna et specie supplicum *delati sunt*.

Were fain to trudge to Rome. (Phil. Holland.) So also Liv., v. 45, 3.

Tac., Ann. ii. 17.

Simul pedestris acies *infertur*.

Liv., xxii. 55, 9.

Simul latebras eorum improvida *praeterlata* acies est.

Cf. also Caes., G. vi. 42 ad fin. Virg., Aen. vii. 217 : *afferimur*. Lucr., i. 207.

Flecti. Tac., Ann. i. 16.

Aut *flexo* in vesperam die.

At nightfall; as daylight turns to eventide. Cf. Lewis and Short, s.v.

Frangi. Lucr. iii. 155.

Corpore ; et *infringi* linguam vocemque aboriri.

The tongue falter, the voice die away. (Monro.)

Cf. κὰμ μὲν γλῶσσα ἔαγε.

Fundi. Tac., Ann. i. 23.

Alii ad quaerendum corpus *effunderentur*.

Tac., Ann. i. 11.

At patres in questus, lacrimas, vota *effundi*.

Caes. G. vi. 26.

Ab ejus summo sicut palmae, rami quam late *diffunduntur*.

In these passages the reflexive force of the verb is very clear : they scatter about to search for the body; they dissolve into tears and plaints ; the horns spread themselves out like palm-branches.

Virg., Georg. ii. 510.

Gaudent *perfusi* sanguine fratrum.

They revel as they wallow in their kinsmen's blood.

Cf. also Caes., G. vi. 37 ; Ovid, Met. i. 36, *diffundi ;* Ovid, Met. i. 484, *suffunditur ;* Virg., Aen. vi. 307, *funduntur ;* Lucr., i. 39 ; Lucr., i. 353 ; Ovid, Fast. i. 215. So cruore suffunduntur oculi—the eyes become bloodshot. Lacrimis

oculos suffusa nitentes, in which case *suffusa* is causative middle, and *oculos* the direct acc. Madvig, loc. cit., includes *fundi* with its compounds among reflexive verbs.

Geri. Lucr., i. 442.

Aut erit ut possint in eo res esse *gerique*.

Lucr., i. 472.

Nec locus ac spatium, res in quo quaeque *geruntur*.

Gigni. Lucr., iii. 173.

Et in terra mentis qui *gignitur* aestus.

And on the ground the turmoil of mind that arises. (Monro.)

Cic., Lael. 21.

Cavendum vero . . . ex quibus jurgia, maledicta, contumeliae *gignuntur*.

Whence arise strife, evil-speaking, and insolence.

Lewis and Short, s.v., practically concede this use of *gigni*: they write as follows: "In *pass.* to be born, to spring, arise, proceed."

Lucr., iii. 337.

Praeterea corpus per se nec *gignitur* unquam.

Nothing, moreover, ever comes into existence of its own accord.

Indui. Virg., Aen. ii. 392.

Androgei galeam clipeique insigne decorum
Induitur.

He proceeds to put on the helmet and the handsome and conspicuous shield of Androgeos. (Lee and Lonsdale.)

Ter., Eun. iv. 4, 40.

Et eamst [sc. vestem] *indutus*. (Reading varies between *ea* and *eam*.)

Cf. *induitur* faciem Dianae; and Cic., De Orat. 3, 32, 127

Aen. ii. 275.

Qui redit exuvias *indutus* Achilli,
Vel Danaum Phrygios *jaculatus* puppibus ignis.

Who [sc. Hector] returns, having donned the spoils of Achilles, &c.

Jaci. Trans-jici, traici. Liv., xxi. 29.

Dum elephanti *trajiciuntur*. (Many of the elephants on this occasion got rid of their drivers and swam the Rhone.)

Lewis and Short, s.v., give many instances parallel, but they mark the words *passive*.

The locution *trajectus* pedes seems to come under the same head.

Jugulari. Tac., Ann. i. 18.

Aut *jugulatus* poenitentiam accelerabo. With which compare—

Plaut., Stich. 423.

Ita me auctores fuere, ut egomet *me* hodie
Jugularem.

Jungi. Lucr., iv. 726.

Multa modis multis in cunctas undiqua partes
Tenuia, quae facile inter se *junguntur* in auris.
These fine bodies "easily join themselves together."

Hor., Od. i. 33, 8.

Appulis *junguntur* capreae lupis.
She-goats will associate with Apulian wolves.

So in the expression dextra dextrae *jungitur*—"hand clasps hand."

Sæpe sensu obscaeno, ut ap. Juv., vi. 41.

Lavari. Lavatus; lautus; lotus; illotus.

Form noticed by Madvig, and fully illustrated by Lewis and Short, s.v.

-lini. Tac., Ann. ii. 17.

Oblitus faciem suo cruore.
Having smeared his face with his own gore.

Lustror. Virg., Aen. iii. 279.

Lustramurque Jovi votisque incendimus aras. (Conington marks this verb as "middle.")

-mitti. Lucr., iv. 681.

Permissa canum vis.
The far-reaching power of scent in dogs.

Cf. Quadriga *permissa*—a coach caused to go at full speed.

Cf. 688, *permitti.* Senec., De Ira: Animus, si in iram se projecit, non *permittitur* reprimere impetum. Cf. Forcellini, s.v.

[Lucan, vii. 625.

Quis cruor *emissus* perruperit aëra venis.

[The passage in Lucan is a laboured description of the horrors of a battle, "the lifeblood gushing out," &c.]

Lucr., i. 92.

Muta metu terram genibus *summissa* petebat.
Speechless with fright, she slipt down on her knees.

Cf. Suet., iii. 20: *se*que patri ad genua *summisit.*

In prose Lucr. would write genibus summissis (cf. summisso poplite). This sliding of participles from construction to con-

struction without essential change of meaning arises necessarily from the highly inflexional condition of the language.

Morari. Plaut., Most. iii. 2, 159.

Apage istum . . . nihil *moror* ductarier.

Plaut. i. 1, 54.

Nunc unae quinque *remorantur* minae.
This is a causative middle.

Mutari.

A very interesting word.
In the active form it is used absolutely.

Liv., iii. 10, 6.

Ut nihil odor *mutaret.*

Liv., v. 13, 1.

Annona ex ante convecta copia nihil *mutavit.*

Liv., ix. 12, 3.

Adeoque . . . animi *mutaverant.*
Cf. also Liv., xxix. 3, 10: *mutasse.* Liv. xxxix. 51, 10: *mutaverint.*

Lucr., i. 686.

Mutato ordine *mutant.*

Plaut., Prol. Amphit. 54.

Deus sum, *commutavero.*

Sometimes the reflexive *se* comes in:—

Plaut., Amphit. 270.

Neque *se* luna quoque *mutat.*

Alongside of these variations we have *mutor.*

Lucr., i. 165.

Nec fructus idem arboribus constare solerent,
Sed *mutarentur.*
Nor would the same fruits keep constant to trees, but would change. (Monro.)

Tac. Ann., i. 44.

Discurrunt *mutati* et seditiosissimum quemque vinctos trahi.
They change sides, and away go they, and drag the most disaffected in chains.

Plaut., Amph. 889.

Ita nunc homines *immutantur,* postquam peregre advenimus.

Lucr., i. 802.

Sic alias aliis rebus *mutarier* omnis.

Ovid, Met. i. 409.

Mutatur in ossa.

From *mutor, muto*, the transition to *moveor* and *moveo* is brief.

Moveor has been recognised as a deponent verb by grammarians, and in Lucretius is frequently used.

Cf. Lucr., i. 341, 375, 431, et passim; also Caes., G. ii. 31, Liv., xxii. 5, 3; and

Liv., v. 49, 1.

Gallos *summoveri* jubet.
He commanded the Gauls to void. (Phil. Holland.)
In mod. Eng., to clear out.

-premo. Plaut., Most. i. 3, 46.

Vix *comprimor*, quin involem illi in oculos
Stimulatrici.

I hardly restrain myself from flying at the eyes of yon bawd.

Queatur.

Queor = queo. Thus:

Lucr., i. 1045.

Dum veniant aliae, ae suppleri summa *queatur*.

Lucr., iii. 785.

Denique in aethere non arbor, non aequore in alto
Nubeis esse *queunt*.

See, further, Lewis and Short, s.v.

Rumpi. Ter., Adelph. 588.

Aeschinus odiose cessat; prandium corrumpitur.
Aeschinus is abominably late; the dinner is spoiling.

Sisti. Liv., ii. 29, 8.

Nec *sisti* posse.

Liv., ii. 44, 10.

Sisti potuisse.

Liv., iii. 9, 8.

Nec potuisse *sisti*.

Liv., iii. 20, 8.

Sisti posset.

Also a crucial passage in

Liv., iii. 13, 6.

In vincula conjici vetant; *sisti* reum, pecuniamque, nisi *sistatur*, populo promitti, placere pronuntiant.

The tribunes forbid his being cast into chains; they announce it as their pleasure that the defendant is *to appear* [*i.e.*, to present himself], and, in case of *non-appearance*, his property is to be sequestered.

Solvi. Lucr., iii. 330.

Extrahere haud facile est quin omnia *dissolvantur.*

It is not easy to withdraw . . . without dissolving all alike. (Monro.)

Lucr., i. 764.

Atque in eas rursum res omnia *dissolvuntur.*

Spargi. Tac., Ann. i. 56.

Reliqui omissis pagis vicisque *dispergunlur.*

The remainder disperse.

Lucr., i. 309.

In parvas igitur partis *dispergitur* umor.

The moisture disperses into particles.

Sterni. Virg., Aen. xi. 87.

Sternitur et toto projectus corpore terrae.

The meaning here evidently is that Acoetes, while being led along, keeps throwing himself on the ground, as Heyne rightly takes it. So Conington in loco.

Cf. common use of *stratus* for "laying oneself flat." Hor., Od. i. 1, 22.

Sumi. Ovid Met. i. 742.

Contrahitur rictus; redeunt humerique manusque;

Ungulaque in quinos dilapsa *absumitur* ungues.

Her great wide mouth contracts, her shoulders and hands return, and each hoof has shrunk and divides into five fingers (lit. nails).

Suspendi. Lucr., iii. 196.

Namque papaveris aura *suspensa* levisque.

Lucr., v. 1096.

Suspensi teneros imitantur dentibus haustus.

With lightly-closing teeth they make a feint of swallowing them. (Monro.)

Hor., Sat. i. 6, 74.

Laevo *suspensi* loculos tabulamque lacerto.

Having hung bag and slate on the left arm.

Tegi. Tac., Ann. ii. 13.

Contectus humeros ferina pelle adit castrorum vias.

Ov., Met. i. 43.

Jussit et *extendi* campos, subsidere valles,

Fronde *tegi* silvas, lapidosos surgere montes.

He bad also the plains to extend, the vales to sink, the woods to take their leafy covering, the rocky mountains rise.

Tendi.

Cf. Lewis and Short, s.v. extendere, who mark the verb as "middle."

Plaut., Frag. apud Scholiastem.

Anus haec in pellis periculum *protenditur*.

This old woman is swelling out to the peril of her skin.*

Cf. passage quoted in Lewis and Short, s.v. prester: quem percusserit *distenditur*, enormique corpulentia necatur extuberatus. The prester is a kind of snake, and whomsoever he strikes swells out, and, expanding, is choked, &c.

Cf. Ov., Met. i. 43, quoted under *tegi*.

Teri. Lucr., i. 898.

Arboribus vicina cacumina summa *terentur*
Inter se.

Contiguous tops of tall trees rub together. (Monro.)

Trahi.

See Ovid, Met. i. 742, quoted under *sumi*.

Vehi. Liv., v. 8.

Utrimque *invehi* hostem nuntiaretur.

Where *invehi* = *invehere se*, as in

Liv., xl. 39 ad fin.

Invehebant se hostes.

Liv. xxxi. 35, 3.

Invehentem se effuse hostem.

In these and similar passages notice that *invehi*, though clearly equivalent to *invehere se*, is not quite within the scope or meaning of the expression *invehi* equo, *invehi* curru, *advehi* plaustro (as in Liv., ix. 3, 9), although about these there is a certain reflexive force, *riding* on a horse, in a coach, in a cart, where the action is done for one's own advantage, as the grammarians note, s.v. Greek middle voice. The notion of rushing advance is well exemplified in

Liv., ii. 20, 4.

Exsules ferociter citato agmine *invehi*.

The banished men charged with great bravery, &c.

Cf. also Liv., vi. 12, 10.

Hence there arises a transference to vehement political attack: cf.

Liv., iii. 48, 4.

Appi, primum ignosce patrio dolori, si quid inclementius in te sum *invectus*.

Cf. also Liv., i. 50, 3, and iii. 9, 6. Tac., Ann. i. 13.

Provectus :—

Liv., xxxv. 48, 11.

Provectus deinde in maledicta.

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* From this and similar places we may conjecture that Plautus and not Dickens wrote The Pickwick Papers.

Tac., Hist. iv. 7.

Per altercationem ad continuas et infestas orationes *provecti sunt.*

Tac., Ann. ii. 55.

Eo usque corruptionis *provectus* est.

Provecta nox (Tac., Ann. xiii. 20).

Provectus aetate, *provecta* senectus, clearly come within the scope of the reflexive or middle verb.

Circumvehi :—

Liv., iii. 28, 1.

Equo *circumvectus* contemplatusque qui tractus castrorum sit;

and absolutely in

Liv., x. 29, 12.

Quingentos fere equites excedere acie jubet, et *circumvectos* a tergo Gallicam invadere aciem.

Curtius, iv. 15, 5.

Equitibus ad diripienda hostis impedimenta *circumvehi* jussis.

Cf. Liv., xxi. 54, 1.

Evehi :—

Liv., v. 36, 7.

Quintus Fabius *evectus* extra aciem equo.

On which cf.

Liv. xxix. 34, 12.

Primo incaute *se evehentes* Massinissa excipiebat.

Cf. Liv. iv. 33.

In the sense of travelling about we find *vehor* and its compounds commonly used:—

Liv., i. 21, 10: curru arcuato. Tac., Ann. i. 15: curru. Plaut., Amphit. 833: una navi.

Cf. also Liv., iii. 70, 6: *reveheretur*. Hor., Sat. ii. 5, 4: *revehi*. Liv., ii. 47, 6: *revectus*. Liv., ii. 47, 3: *advectus*. Tac., Ann. ii. 5: *advectus*. Tac., Ann. i. 51: *advectus*. Plaut., Amph. 325: *vectus*. Plaut., Amph. 724: *vectus*. Tac., Ann. i. 63: *evehi*. Doubtless the force of the reflexive in these expressions is causative.

[A familiar instance in a derived language will be *promener, se promener; promener un enfant,* take a child out for a walk; *se promener à cheval,* take oneself out for a turn on horseback. The general disuse of the passive voice in modern French and its replacement by impersonals or reflexives is noticed above.]

Verti.

Verto is used intransitively in a somewhat middle or reflexive sense.

Liv., iii. 64, 1.

Haec victoria prope in haud salubrem luxuriam *vertit.*

Liv., ii. 3, 3.

Libertatem aliorum in suam *vertisse* servitutem.

Liv., ii. 62, 2.

Omnis ira belli ad populationem agri *vertit.* (Where clearly the wrath of the troops *directs itself* against the fruits of the soil.)

Cf. also Liv. iii., 36, 7, and

Liv., v. 49, 5.

Jam *verterat* fortuna.

Cf. also Tac., Ann. i. 18.

Sometimes the reflexive form is that found in the Romance languages.

Ter., Adelph. 286.

Ego jam transacta re
Convortam me domum.

Side by side with this instance notice

Ter., Phor. 312.

Ego deos penatis hinc salutatum domum
Devortar.

Periocha in Hauton. Tim. 4.

Clam patrem *devortitur.*

Ter., Eun. 588.

Deum sese in pretium *convortisse.*

Lucr., i. 678.

Convertunt corpora sese.

Liv., ii. 24, 5.

Nec posse bello *praeverti* quicquam.

Also Liv., iii. 40, 14; Plaut., Amphit. 914; Tac., Ann. ii. 55; Virg., Aen. i. 317.

Reverti:—

Liv., ii. 46, 6.

At ego injuratus, aut victor *revertar.*

Cf. also Ter., Andr. iv. 4, 740; Ter., Adelph. iv. 1, 525; Plaut., Amph. 653; Lucr., i. 237 and 756; Caes., G. ii. 35; iii. 7.

Converti:—

Hor., Od. iii. 16, 8.

Converso in pretium deo.

The divinity that turned himself into pelf.

Liv., iii. 8, 5.

Et consul Nuntio circumventi fratris *conversus* ad pugnam.

Liv., iii. 6, 4.

Eo vis omnis tempestasque belli *conversa* est.

Cf. Tac., Ann. i. 45, and ii. 39; Plaut., Amphit. 284 and 682.

Averti:—

Liv., ii. 487.

Aut *averti* alio sinebat.

Cf. Plaut., Amphit. 893: *avortisti*.

Liv., ii. 8, 8, and xxii. 13.

Verti:—

Liv., v. 29, 8.

Quae [sc. plebs] jam in suos *versa* non intelligeret.

Who now setting themselves against their own patrons. (Holland.)

Cf. also Liv., iii. 28, 9; ix. 2, 13; ix. 2, 15; Lucr., i. 710; Ov., Met. i. 235.

Examination of all the passages above will show the active *sense* of the verb, whatever *form* it takes.

Volvi. Tac., Ann. i. 23.

Cum deprecandi causa paulatim introisset ambulantisque Tiberii genua *advolveretur*.

Tac., Ann. i. 23.

Praeceps et singulorum pedibus *advolutus*.

In both passages the person rolled himself grovelling at the feet and knees of other men.

Virg., Aen. vi. 659.

Plurimus Eridani per silvam *volvitur* amnis.

Eridanus' mighty flood rolls through the forest.

Cf. also Virg., Aen. vii. 349, of a snake coiling itself.

These few instances may serve to indicate the line of argument. More may easily be added. But it will suffice in the present case to have drawn attention to a somewhat neglected point in Latin grammar. All translations will gain in force and vividness were it clearly recognised that the so-called passive, like a certain classic piece of furniture, "contrives a double debt to pay." So also our translation will be more suggestive and profitable were it admitted that the analogies of meaning attract inflexions rather than that inflexions control shades of meaning.

Art. II.—*Notes on the Land-system of the Iliad.*

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The general word for wealth springs from a radical √KT. Hence κτήματα, κτέατα (κτέαρ), κτῆσις, κτέρας, πολυκτήμων, κ.τ.λ.

In the early reckoning of Wealth the notion of property in Land is not included. Thus, as noticed by Varro (L.L.), cattle (*pec-ora*) are the staple of wealth. *Pec-unia* is used of crops, goods in kind, and coined money. So νόμισμα, νομὸς, νόμος, νέμω, *nummus*, to denote custom, customary coin, custom in land, assigned land out of the common land.

In Greek literature no coined money is mentioned prior to Hdt. i. 94, on which Rawlinson and others state that no coined money has been found in Assyrian or Lydian ruins. There is no reference to money as coined by the Jews prior to 1 Maccab. xv. 6. Wealth is reckoned, then, in kind or cattle; not in land or money. So, a wealthy person is called—

πολυκτήμων,	πολύχαλκος,
πολύμηλος,	πολύκληρος,
πολύαρνι,	πολυλήιος
πολυπάμων,	πολυβούτης,
πολύχρυσος,	ἀλφεσίβοια.

Many of these words are restored from oblique cases. Of these, three alone have any traceable reference to property in land: πολυκτήμων, πολυλήιος, πολύκληρος.

v. κτᾶσθαι, according to L. and S., is not used of property in land, in any place in Greek literature. It is not used of land-property in the Iliad. In Il. ix. 402 (wherein the form is Ionic) it is used of the capture of a town:

Ἴλιον ἐκτῆσθαι εὖ ναιόμενον πτολίεθρον.

In Od. xxiv. 193 it is used of winning a wife:

ἦ ἄρα σὺν μεγάλῃ ἀρετῇ ἐκτήσω ἄκοιτιν.
(A wife of worth abundant hast thou surely gotten thee.—W. M.)

The meaning of wealth vanishes from the noun in Babrius, Fab. lii.:—

ὦ παγκάκιστον κτημάτων τί δὴ κρώζεις;

πολυκτήμων is ἅπαξ λεγόμενον in Homer, wherein the caution of Phrynichus (§ 206) may be noted: ἡμεῖς οὐ τοῖς ἅπαξ εἰρημένοις προσέχομεν τὸν νοῦν, ἀλλὰ τοῖς πολλάκις κεχρημένοις.

The ἅπαξ in H. is Il. v. 613:

ὅς ῥ' ἐνὶ Παισῷ
ναῖε πολυκτήμων πολυλήιος.

Editors of H. (l.c.) make no remark; a parallel passage in Soph., Antig. 843, gives no help. The two epithets describe a wealthy man rich in chattels and standing corn.

Examine the cognate ἀκτήμων—Il. ix. 126 (same passage is repeated, ix. 264). The passage is said to be spurious. Paley thinks ἀκτήμων a post-Homeric word: quotes Theocr. xvi. 33, but does not notice ἀκτήμων in his tract on Post-epic words in Homer.

In Il. ix. 126 the whole sense is against the inclusion of land as property. There is a full enumeration of goods and cattle and slaves (cf. the vow of Ascanius in Æn. ix. 260), the like of which if a man had he would not be ἀκτήμων ἐριτίμοιο χρυσοῖο.

Next consider πολυλήιος (cf. ἀλήιος). L. and S. take this to signify wealthy in land on which corn is growing—rich in cornfields.

Autenreith, s.v., gives "rich in harvests." The passage quoted is Il. v. 613 (cf. above πολυκτήμων). The word is also ἄπ. λεγ. The passage may comprise either mere redundancy of epithet, or identifies two kinds of property: property in goods (κτήματα), property in land-produce (λήϊον).

The question arises, What is the meaning of -λήϊος? λήϊον in H. is used of the *uncut crop* (*segetes*). Cf. Il. ii. 147:

ὡς δ' ὅτε κινήσῃ Ζέφυρος βαθὺ λήϊον ἐλθών.

(As when the Zephyr cometh, and stirreth the lush corn, and with sudden rush sends the ears a-nodding.)

Cf. also Il. xi., 560:

κείρει τ' εἰσελθὼν βαθὺ λήϊον (sc. ὄνος νωθής).

(The ass, heedless of blows, goes and browses on the lush corn.)

(νωθής may be an *epitheton constans* of the ass; or here the significance may be that, having once got into the midst of such fodder, he cannot be got to budge by blows, or anyhow;—if this be so, the epithet is proleptic.)

If this be the meaning of λήιον, there is no trace of it in ἀλήϊος as in Il. ix. 260, in ix. 125, and vi. 201. The scholiast explains, "ἐλλιπὴς βοσκημάτων." In the passages cited the wealth is neither of cattle nor of land. Great wealth is indicated nevertheless. Seven tripods, ten talents of gold, twenty burnished cauldrons, twelve sturdy racers, seven maids skilled in fine needlework—Lesbian girls who in beauty excel all women: had a man such goods as these he were surely no pauper (ἀλήϊος).

This famous passage has caught the fancy of Xen. (Sympos. iv. 45), and Ovid (Her. iii. 31, 36), and Virgil (Æn. ix. 260, seqq.). Translators evade ἀλήιος. Paley thinks no satisfactory derivation possible. In any case there is no reference to

land in severalty in the passages wherein the word occurs. Although, then, the meaning of -λήιος might have been illumined by the admitted meaning of λήιον, no such light is forthcoming. A possible connection with λεία (λαία) has been suggested, and is very likely. Note, however, λεία seems to be restricted to booty of cattle and movables, is rarely used of men, and in the nature of the case could not be used of land.

Πολύκληρος is not found in Il., but κλῆρος occurs in Il. xv. 495, seqq., where we read that—The warrior dies no unseemly death who falls fighting for his country:

> ἀλλ' ἄλοχός τε σόη καὶ παῖδες οπίσσω
> καὶ οἶκος καὶ κλῆρος ἀκήρατος.

(His wife, his children, his homestead, and his κλῆρος remain uninjured.)

What is κλῆρος?

Autenreith, s.v., thinks κλάω a cognate. Wharton agrees. In this case κλῆρος means a sherd, a broken twig, a morsel of stone, anything convenient for the casting of the lot.

In Babrius, lxx. 2, the gods are said to marry κλήρῳ, and Ὕβρις becomes the spouse of Ἄρης.

The main idea is allotment by chance. Cf. Il. vii. 175. Nine heroes cast lots which of them is to encounter Hector in the duel:

> ἐκ δ' ἔθορεν κλῆρος κυνέης ὃν ἄρ' ἤθελον αὐτοί
> Αἴαντος.

In the Dictt. the history of the word is traced until the getting of property in the ordinary course of heritage or commerce is reached.

Cf. Demosthenes, 329, § 15: κεκληρονόμηκας μὲν Φίλωνος τοῦ κηδεστοῦ χρημάτων πλειόνων ἢ πεντεταλάντων.

In Historic times occurs the well-known instance of tenure by κλῆρος in the case of lands annexed by Athens. Evidence goes to show that a slice of arable, of pasture, and of woodland constituted the κλῆρος of the Athenian squatter.

If the squatter (κληροῦχος) preferred his home in Athens he paid a heavy absentee-tax, which in every case amounted to the same sum. The tax tends to prove that, in the case of annexed land, pastures forests and fields were parcelled out into separate patches, and that a κλῆρος consisted of an aggregation of three such patches.

The κλῆρος then within historic times denotes severalty of permanent tenure with rents appertaining, and a fixed tax in case of absenteeism.

Ridgway (loc. cit.), Journal of Hellen. Stud., p. 331, Oct., 1885, holds that κλῆρος need mean nothing more than that the right to a portion in the common fields shall be preserved,

and that care shall be taken to protect the widow and orphans against those who would remove the landmarks.

I notice that the distribution by the King of Phæakia of common land (cf. Od. vi. 9, 10), as well as the mode of distribution by lots (κλῆροι), comes within the scope of the system prevalent in Italy within historical times.

Publicus ager is common land, formally surrendered by a foe after warfare (Liv. i. 38, 2).

"Publicatur is ager qui ex hostibus captus sit," is the definition of the jurist. Land thus brought *in publicum* was devoted to meeting State expenses. In this way the Roman Government was the ground-landlord of whole cities and countries.

A State cannot farm the acres of a continent: hence the *publicus ager* was assigned, subject to resumption at will, on easy terms, usually at 10 per cent. of the gross value of the annual produce. This tithe was recoverable immediately by State officials. The occupation of *publicus ager* is called *possessio;* hence *possessor* is a tenant-at-will, one who does not hold permanent interest in any property.

So Livy, *passim*, ii. 42, 2: "Id multos quidem patrum, ipsos possessores, periculo rerum suarum terrebat." Cf. also ii. 61, 2; iv. 36, 2; vi. 5, 4; vi. 35, 5.

The last place cited quotes part of the Licinian Land Bills of 377 seqq. B.C.: "Ne quis plus quingenta jugera agri possideret."

Possessio, although of the nature of tenancy at will, was alienable and transmissible as leasehold property. *Publicus ager* was sold, as by Appius Cæcus to defray the expenses of his engineering works and improvements, but never seems to have been given away in absolute gift; at any rate not in the earlier Roman days: nor does it appear that gentlemen in Rome were at liberty to settle on large tracts of public land according to their willingness to bear the tithe-charge. The area of the tenement was limited by many laws, while about 312 acres seems to have been the legal maximum of holding.

This distinctive meaning of *possessio* holds good throughout the Latin period.

"Possessio est usus agri aut aedificii, non ipse fundus aut ager."—Paul. Diac. on Festus, p. 232.

"Possessiones appellantur agri late patentes publici privatique, qui non mancipatione sed usu tenebantur, et ut quisque occupaverat, possidebat."

It seems from the above that *possessio* is akin to the Homeric κλῆρος (loc. cit.)—that is, the right of use, but not land or domain in freehold.

Severalty in land-tenure with right of testament in land indicates severalty of homestead and residence. The farmer's

house and land, the landlord's house and land, are conceptions that have some correlation in fact. That a man should dwell in the midst of his land seems an appropriate arrangement.

Society, as Ridgway points out, seems to be in the house-community stage.

In Priam's house, Il. vi. 243, the whole of his family dwell together:

ἀλλ' ὅτε δὴ Πριάμοιο δόμον περικαλλέ' ἵκανεν.

* * * * *

πεντήκοντ' ἔνεσαν θάλαμοι ξέστοιο λίθοιο.

It contains fifty apartments built of polished stone. The sons of the monarch, his daughters, live with their spouses beneath a common roof. The passage in Virgil repeats the intimation afforded by the Iliad. A man's kinsfolk are *ἐφέστιοι*, they belong to the same hearth. This may be an epithet surviving from an older time, but it is significantly appropriate to the conditions of the only known Trojan household. The term is also applied to the native Trojan as distinct from foreigners (*ἐπίκουροι*).

In the Odyssey the house of Menelaos at Sparta, of Alkinoos in Phæakia, of Odusseus in Ithaka, are described; but this circumstantial detail is omitted: a point which, taken with other considerations, goes to show that the social life of the Iliad is remote from that of the Odyssey.

This common house points to common land; and there is a fine passage in Il. xviii. 541, to which attention may now be directed:

ἐν δ' ἐτίθη νειὸν μαλακήν, πίειραν ἄρουραν,
εὐρεῖαν τρίπολον, κ.τ.λ.

The poet is describing the Scutum Achillis, and says the craftsman wrought into it "a loamy rich land, fallow, broad, and thrice ploughed (*τρίπολον*); and many ploughmen in the fallow drove their teams up and down, turning at the headland; and when they had done their turn, and had reached the top of the land, a man came forward, and gave to each into his hands a stoup of rich wine, while others were doing their turn up the furrows and were driving to reach the headland of the deep-soiled field."

This is the famous Ploughing of the Fallow in the Scutum, and the conjecture is reasonable that it indicates a ploughing of the common land simultaneously by all interested on a day fixed by authority or custom. Doubtless the labour was begun by all at once, at an annual date, such as was, among our forefathers, Plough Monday.

The word *τρίπολον* is bracketed into the text above, as deserving some consideration in detail. The customary translation "thrice ploughed" has been used; but this translation

is a matter for argument. Etymology shows πελ- and *col-* to be cognate stems. αἴπολος, βούκολος, *polus*, *callis*, *currere*, *colere*, carry with them the notion, active or passive variously, of movement. τρίπολ- is clearly indicative of movement thrice repeated, whether continuous or in interrupted succession.

"Thrice ploughed" is in such case clearly admissible, although I do not recall an illustrative parallel instance of πελ- being used of ploughing.

In this context Seebohm (p. 11) furnishes a suggestion: he is writing about the Manor of Hitchin. All the customs of the Manor are of great antiquity; the boundaries are marked according to a form used two thousand years ago, during the Roman occupation, and uninterruptedly from that time to the present period.

The common fields of the Manor are six; and it is recorded that these common fields have immemorially been, and ought to be, kept and cultivated in three shifts by rotation—in *tilth-grain*, in *etch-grain*, and in *fallow*.

This three-shift system is found established in China, where it has prevailed from time immemorial. It has prevailed in England up to the time of our grandfathers. England contains (say) ten thousand parishes; and up to 1844 a very large number of Enclosure Acts—perhaps about four thousand—have been passed. The Enclosure Acts, as is well known, dealt with common land, and put an end to both the tenure and the system of common cultivation. The custom was therefore very ancient, and has been very extensive.

Now, in the Scutum the rich nature of the soil bars the need of increased ploughing. Sour and stiff soils require the plough to be run up and down them to admit air and sunlight, that the land may be sweetened: a good soil does not need such physic. It is dubious, also, whether triple ploughing has a very high antiquity, or whether such ploughs as Colonel Leake conjectures to have been used in the Homeric period are fit for the deep ploughing suggested by τρίπολον and its context. It suggests itself to me that τρίπολον is the *three-shift* system, indicated by an *epitheton constans*, and grouped with the epithets descriptive of the soil itself. If this suggestion be admissible, the famous Ploughing of the Fallow is a picture which may have been true of the Common Field of Hitchin a century ago.

Note, in continuation of the main argument, a consideration based upon Il. xxii. 489:

ἄλλοι γάρ οἱ ἀπουρήσουσιν ἀρούρας—

On which Paley (in loco) makes the note: "ἀπουρήσουσιν, 'will take away,' a future from ἀπαυράω, or rather from an aorist ἀπουρεῖν regarded as a present. . . The future does not occur again in Homer."

Autenreith, s.v., says: "ἀπουρήσουσι, fut., *eripient* (-αὐράω), or ἀπουρίσσουσι, *amovebunt terminos* (οὖρος)." The passage is, then, "for others will take away his landmark; will intrude upon and usurp his land."

L. and S. adopt ἀπ-ουρίσσουσι as the reading in this place. Ridgway follows. The difficulty about ἅπαξ λεγόμενα felt by Phrynichus arises in the case of ἀπ-ουρήσουσι. The form is conjectural; the meaning is still more conjectural.

The question is, What is οὖρον? In the Dictt. there are six words of this sound—οὖρον, οὖρος, οὖρον, οὖρος, οὐρὸς, οὖρος—and under the head of the first οὖρον we find in all Dictt. the following references:—

Il. xii. 421–424:

ἀλλ' ὥς τ' ἀμφ' οὔροισι δύ' ἀνέρε δηριάασθον
μέτρ' ἐν χερσὶν ἔχοντες, ἐπιξύνῳ ἐν ἀρούρῃ
ὥ τ' ολίγῳ ἐνὶ χώρῳ ἐρίζητον περὶ ἴσης,
ὣς ἄρα τοὺς διέεργον ἐπάλξιες· . . .

This is Englished by Lord Derby,—

"As when two neighbours in a common field
Each, line in hand, within a narrow space,
About the *limits* of their land contend,
Between them thus the rampart drew the line."

Another more significant passage is Il. x. 351:

ἀλλ' ὅτε δή ῥ' ἀπέην ὅσσον τ' ἐπὶ οὖρα πέλονται
ἡμιόνων (αἱ γάρ τε βοῶν προφερέστεραι εἰσίν
ἑλκέμεναι νειοῖο βαθείης πηκτὸν ἄροτρον).

On which editors, as to οὖρα πέλονται ἡμιόνων, are in difficulty.

A third illustrative passage, Il. xxiii. 431, 443:—

ὅσσα δὲ δίσκου οὖρα κατωμαδίοιο πέλονται.

(So far as reach the casts of a well-hurled quoit.)

In all these cases οὖρον is a land-measure.

Men are disputing about the οὖρα of their land. (I do not think Lord Derby should be reckoned in evidence either way; his translation does not aim at critical accuracy). They hold the measures in their hands:

Or they are playing quoits, and go a fixed cast called οὖρον:

Or mules are ploughing, and, being nimbler at the plough, they do in the same time more work than do the oxen; and it seems that the work in a fixed time (say a working day) between headland and headland—that is, the total *width* of the land ploughed—is called οὖρον.

Consider the circumstances and context of the following reference: Diomedes and Odusseus are prowling about at night; they meet Dolon, who is also out on a midnight

errand, and resolve to kill him. They step aside somewhat from the beaten track, and allow him to pass by. As soon, however, as he had got away from them an *οὖρον* they start to catch him. He immediately hears the thud of their feet, and stops to listen. Take it that *οὖρον* is a furrow-length, surely this is an unwonted start to give a man, unless your furrow is very short: again, at a furrow-length sound would scarcely reach his ears. Not to press the words into too literal a mould, we may infer that, as a standard of measurement, *οὖρον* means a shorter rather than a longer distance.

In Od. viii. 120, seqq., a foot-race is described, and the successful competitor beats the others by the measure *οὖρον ἡμιόνοιιν*—not a long distance, for they were all swift-footed; they stir up the dust of the plain as they go.

Clearly the measure is a fixed, if somewhat loose, standard of reference, like pistol-shot, stone's-throw, lump of chalk, bit of string (fathom), bow-shot, ear-shot. So have I heard the great splashes of rain fresh-fallen on a sun-baked pavement compared in size to eighteenpence.

The distance of an *οὖρον*, either as a start or as a finish, cannot be great. Dolon gets an *οὖρον* start, and the Phæakian athlete wins by an *οὖρον*. The word clearly comes within the scope of a short measure of some kind. I take it to mean a measure of width. In a similar way our forefathers used "rod" or "rood": so many furrows lengthways multiplied by so many rods breadthways make an acre. Our forefathers knew nothing about a standard-acre any more than they knew a standard-mile. An Irish mile is a painful distance for a weary traveller to contemplate; a German acre is a puzzling thing to calculate. The English, the Flemish, the German, the French ell present a pleasing variety: they take their rise from the length of a man's forearm, but how I do not know.

οὖρον may be cognate with the Ionic *εὖρος*—a word not found in the Iliad, once in the Odyssey. *εὖρος* is used of width on the grand scale, as *e.g.* of big rivers, but without any approach to definite significance. *οὖρον* is used, however loosely, to indicate a unit of measure.

Hence we explain the *οὖρον ἀρούρης* as the side-marks and not the end-marks of a field: the balks and not the headlands (*τέλσον ἀρούρης*) of a man's share in the common field. If this be so, we arrive at an ancient system of landmarks or measurements arising out of common rights in common land.

The width of the *οὖρον* will, of course, depend upon the length of the furrow. Now, a Furrow is a measure of length better known as Furlong. (*Por*-ca, according to Columella, was, in Spain, a measure of length: *porca* seems to have been a rustic word, and by false analogy is used to indicate a ridge. Colum., ii. 10, 6, used *αὐλακίζειν* as equivalent to *imporcare.*

Im-porc-ι-tor, qui porcas in agro facit arando: ad Virg., G. I, 21. *Furh, furuh, furhi, furrow.* Similar words are *lira, balc,* rig, link, ridge—all indicating the action of the plough.) The furrow is of varied length, but *quarantena,* a late Latin word used in agriculture, goes to show that forty units of some unknown length constitute the furrow-long.

All the ancient village fields of England are divided into acres, furlongs, and rods. The oldest English Bible uses *æceras* for fields. The acre is a furrow of 40 rods long multiplied by an οὖρος of 4 rods: the ancient acres vary according to the lie of the ground cultivated. There is in some places in England a measurement of land called *shot* or *lot,* and many such are mentioned in the plan of Purwell Field, Hitchin (Seebohm, p. 2). These are called "long shots" and "short shots," with regard to which Seebohm points out that the average length of the shot is roughly identical with the statute furlong of 40 poles.

Aristarchus explains οὖρος, οὖρον (s. Il. x. 351) by reference to the fact that mules, being nimbler than oxen, will plough more land between starting-time and sunset. They are προφερέστεραι, and the οὖρα in such a case are wider than the οὖρα of oxen. Evening is ox-loosing time, the day is over when the day's work is over: this is the ancient basis of reckoning; while generally, in the history of nations, the day's work either of a yoke of oxen or of the men who work with the oxen has given rise to the words used in the measure of land.

Thus *actus,* being the drive of the plough through the soil, is used to signify the balk between fields, and also a measure of 120 feet (40 yards): *jugerum,* containing so many *actus,* is the day's work of a yoke of oxen. *Mappa* is 40 perches by 4 perches, and is used of a day's work. "Yoke," "virgate," "bovate," "carucate," arise from a similar method of calculation. "Carucate" is a holding such as can be worked by a full plough-team of eight oxen; "virgate," the work of two oxen; "bovate," the work of one ox. What determines the measure?

"This, too," says Seebohm (p. 124), "is explained. According to Welsh law it was the measure of a day's co-ploughing, that is, twice the work done by an ox between starting-time and mid-day." Hence we have in O. Fr. *jurnel,* L.L. *jurnalis,* Germ. *morgen,* all equivalent to an acre.

It is necessary, in all these and similar references, to clear the mind of the influence exercised by the daily use of fixed standards or measures. All words are loosely used in the early stages of national life: it is vain to search for strictness of meaning in the words employed by men locally separated, although using the same speech, if separation is maintained by fear or by mountains. As the Homeric words of measure-

ment are few and scattered, so they are indefinite. They indicate both process and result: as *actus* signifies both a balk and a measure of length, so οὖρος, in Il. xii. 421, seqq., is used of result, and is translatable "balk," "ridge," "rig," or "link," while in Il. x. 351 it indicates a process: the number of furrows a yoke of mules can lay down in a day, measured breadthwise, is an οὖρον, which may be thus translated "rod" or "rood."

The general argument, summarised, is as follows:—

Wealth is reckoned in kind, not in land. The epithets descriptive of a wealthy man do not include the notion of land. Κλῆρος in the Iliad does not indicate severalty in land: κλῆρος may be illustrated by the Italian *possessio*. The Common House, Il. vi. 243, indicates a probable common-land system.

Τρίπολον is held to refer to the three-shift system of tilling the soil.

Οὖρον is held to mean a balk or ridge in the common field.

The scene in the Scutum Achillis is held to be a scene of common toil in a common field.

The conclusion is that in the Iliad the land-system is most probably a common-field system, in which, however, the beginnings of severalty in land may be traced.

This brings us to the Τέμενος. Grote and others have held that in the Scutum Achillis a full proprietary system is revealed. Grote (ii., p. 108) illustrates further from Od. vi. 9, 10:

ἀμφὶ δε τεῖχος ἔλασσε πόλει, καὶ ἐδείματο οἴκους,
καὶ νήους ἐποίησε θεῶν, καὶ ἐδάσσατ' ἀρούρας·

which William Morris translates,—

"And he drew a wall around the city, and the houses he upreared,
And the shrines of the gods he fashioned, and the fruitful acres shared."

Grote thinks here that the King of Phæakia is handing out land in inheritance, and that there was fixed property in land. ἐδάσσατο does not carry so much with it. The words are quite consistent with the theory of allotment of land from the common land.

The τέμενος is undoubtedly land assigned or land seized. It is cut off or enclosed primarily for sacred purposes, ultimately as private property. The features of the acquisition of landed property in the early stages of society are everywhere the same. Land is held in severalty either by acquisition of grant, or acquisition of seizure. The chieftain takes possession of choice bits of land: he subsequently asks his subjects to register his decision. So, in the scutum, the βασιλεὺς stands like a fine old English gentleman viewing his young men and

maidens at work. At the same time the broad acres being ploughed in the compartment of the shield next to that depicting him and his τέμενος are not his. That he ultimately swallows the acres, ploughmen, and all, is matter of common historical knowledge. But in the Iliad his τέμενος is a little patch which his subjects or his peers grant him out of the common stock.

For him, and his descendants according to the spirit, ancient language finds it hard to coin a suitable name. Where is the word which to the Italian, or to the Greek, comes quite so glibly as to the Englishman his much-used word "landlord"? It is not *dominus*, nor *possessor*, nor *herus*, nor δεσπότης, nor κληροῦχος, nor βασιλεύς.

Art. III.—*Bacteria and their Relation to Disease.*

By Isaiah de Zouche, M.D., Address as President of the Otago Institute.

[*Read before the Otago Institute, 12th November, 1889.*]

It will help us to better understand the widespread revolution in pathological views or doctrines occasioned by the discovery of bacterial agency in disease if we glance at some of the theories which were formerly held regarding the nature of disease—theories which still lurk in the belief of certain classes of the people, just as old styles in dress and old-fashioned modes of speech are found amongst them long after they have become obsolete in the centres of fashion and learning.

At an early period in the history of medicine disease was attributed to alterations of the humours of the body. Hippocrates, born about 450 years before Christ, who has been justly styled "the father of medicine," described certain humours known later as the "cardinal humours," to the derangements of which he attributed various diseases. The humours, according to Hippocrates, were four—namely, blood, phlegm or mucus, yellow bile, and black bile. He held that in order that the body should be maintained in health these humours should be mixed in just proportion as regards quantity and force, but especially that they should be well mixed; that disease results from excess or defect of any of these humours, or from its separation without having been duly mixed with the others. Thus, our word "melancholy," meaning in Greek black bile, denotes an affection in which black bile is supposed to be in excess; a "phlegmatic" temperament characterizes those in whom the cold or phlegmatic watery humour is overabundant; while the word "dyscrasia," meaning a faulty admixture (of the humours), is still used

in medicine to signify an unhealthy habit of body. Hippocrates speaks of remedies which act on particular humours—some on bile, others on phlegm or mucus. Even in our own day we have our cholagogues and hydragogues—terms which have been handed down from these teachings. He attributes most fevers to bile. The humours were supposed to be at first crude, then they underwent digestion—or coction, as it was called—and the diseased fluids were expelled by a crisis. It was a beginning of what is known as the humoral pathology, which has influenced medicine up to our own times. This theory of pathology is, indeed, still in favour at certain hydropathic establishments. Prolonged wet-packing, by interfering with the normal functions of the skin, produces an artificial eczema, and when the watery or purulent rash appears the patient is informed that it is a "crisis," by which the bad humours of the blood are escaping. It is worthy of note that Hippocrates attributed the first cause of diseases to the air (πνεῦμα, *spiritus*). Air was believed by ancient philosophers to contain the vital principle (*spiritus vitalis*), from which it was to be inferred that diseases were caused by some abnormal spiritus in the air, although Hippocrates admits that some diseases may be produced by errors of diet.

Great influence in the causation of disease was attributed by Hippocrates and his successors to the time of the year, summer and autumn being the seasons when fevers were in the ascendant. The constitution of the atmosphere was held to determine in some degree the constitution of the reigning diseases. The observation was perfectly correct, although the manner in which atmospheric conditions influence disease could not be then understood—nor do I by any means assert that they are yet fully understood. To this I will refer later, when speaking of epidemics.

It might be of great interest to trace the slow steps of the growth of medical knowledge, but this would lead us away from our subject without conferring any present benefit.

Medicine had its dark ages. Its practice became strangely mixed up with astrology, incantations, invocations, and charms. Here and there was a spark of light from some original thinker, whose means of research were, however, insufficient to enable him to place his views on any sound basis. Theories reigned in place of facts, and medicine had to await the development of auxiliary and sister sciences before she could even distantly hope to attain the position which I believe she is now rapidly acquiring—namely, that of an exact science.

But a word about the later theories. The chemical theory of disease prevailed in the fifteenth and sixteenth centuries, with which the name of the clever, egotistic, semi-scientific charlatan, Paracelsus, is associated. Its supporters referred pro-

cesses of disease, as well as those of health, to ordinary chemical laws. To these were opposed the vitalists, represented by Van Helmont (born 1577 or 1578), who attributed disease to the disturbances of the vital spirits. These were termed archeus, or, as there were two chief vital principles, archei. They reigned in the stomach and spleen, and dominated the body therefrom, delegating their powers to satraps or minor archei, for the other organs. The belief in a "vital principle" has prevailed since the beginning of medicine, or of biology as a science. The arteries were supposed to contain air, the origin of life, and to convey with it, or in it, the vital spirits throughout the body. Hippocrates, as already mentioned, held the theory of a vital principle, which he believed was in the air, and was drawn in by the breath. Even in the seventeenth century there was not much advance on the Hippocratic pathology. The great English physician, Sydenham (born 1634), attributed the origin of acute diseases to a latent and inexplicable alteration of the air infecting the bodies of men. He speaks of peccant matter, its concoction, fermentation, and despumation.

The humoral theory was opposed by that of the solidists, who referred all diseases to an affection of the solid parts of the body. They held that the solids alone were endowed with vital properties, and alone could receive the impression of agents tending to produce disease.

So far for the general theories which influenced medical thought and practice for centuries. They were destined to be undermined or modified by the more accurate study of human anatomy, which had received such an impetus from the labours of Vesalius (born 1514), in the middle of the sixteenth century, the discovery of the circulation of the blood by Harvey (1616), and especially by the use of the microscope, which Leeuwenhoeck improved materially, and employed in physiological and biological investigation, with important results, towards the end of the seventeenth century.

Pathology, which may be called the physiology of disease, began to emerge from the cloudland of theory into a clearer day, but there were still many things obscure, and which required better methods than were then at command for their elucidation. The phenomena of inflammation especially occupied the attention of pathologists, who believed that in these lay the key to many or most of the morbid changes in the body. Inflammation, from being regarded as a disease, came to be understood as a *condition* of an organ or part induced by some irritation—a process sometimes conservative, sometimes destructive. And recent researches have shown the importance of a correct understanding of this process, for in studying inflamed tissues with the aid of the microscope the

property possessed by the white blood-corpuscles of wandering outside of the vessels was discovered, and also their power of removing substances deleterious to the system, bacteria amongst others. In order, therefore, to be able to follow up the fate of bacteria which find their way into the body, or the fate of the body into which bacteria have been introduced, it will be necessary to direct our attention for a moment to some of the phenomena of inflammation. For our present purpose it will be sufficient to consider the blood, the irritated part, and the blood-vessels in its vicinity. The blood consists of water holding in solution albumen, fibrin, and various salts, with an infinite number of minute cells suspended or floating throughout it. These cells are the red and the white corpuscles. With the red blood-corpuscles we have nothing to do for the moment. It is the white corpuscles, or leucocytes, which claim our attention. The white corpuscles are soft-bodied globular cells about $\frac{1}{2500}$in. in diameter, composed of protoplasm, and possessing a nucleus or nuclei and nucleoli. Sometimes vacuoles are seen in their interior. They have been aptly likened to the Amœba. The Amœba is the simplest form amongst the protozoa. It consists of a minute mass of jelly, a simple cell without organs—unless the nucleus be an organ, or the vacuoles which may appear at any time. It possesses the power of movement by shooting out portions of its protoplasm, which serve as arms or feet (pseudopodia). It nourishes itself by investing any small body capable of affording it nutriment with its protoplasmic substance, surrounding the morsel with its body. It can reject any innutritious or noxious particle which it may have enclosed, by simply withdrawing its body from the particle, and leaving it outside.

The analogy between the Amœba and the white blood-corpuscle, or leucocyte, seems complete. The leucocytes are little particles of protoplasm, monocellular, and nucleated, and sometimes vacuolated. They are endowed with the power of movement by means of little feet-like processes which can be shot out and again retracted. They can take particles of foreign matter into their interior and digest them or reject them, just as the Amœba can do. We have thus living in our blood little cells possessing a life of their own, having the faculty of movement with which our will has nothing to do, of selecting and digesting food, and, as we shall see afterwards, the power of avoiding some matters which would act as poison to them.

And now a few words with regard to inflammation. The definition of Celsus as to the external characteristics of inflammation reigns to this day in our text-books—namely, "redness and swelling, with heat and pain"—"Rubor et

tumor, cum calore et dolore." To be brief, the redness is due to increased flow of blood to the part, the heat to increased oxidation of tissue, and the pain to pressure on nerve-endings. The smaller blood-vessels, termed capillaries, dilate, yet the blood flows slowly, and has a tendency to stagnate. The swelling is caused partly by the increased blood-supply, and partly by the pouring-out from the capillary blood-vessels of a thickish, glutinous, watery fluid termed liquor sanguinis, or lymph, which under certain conditions becomes changed into matter or pus. The examination of lymph showed it to consist of water, albumen, fibrin, and salts, while under the microscope could be seen spherical nucleated cells termed lymph-corpuscles, which are identical with white blood-corpuscles.

The origin of white cells in the liquor sanguinis thrown out by the blood-vessels in inflammation was by no means clear, but a discovery of the highest importance, destined to throw light on this matter, was made by Dr. William Addison, of Malvern, about the year 1843. This was one of the great discoveries in physiology or pathology, and deserves special mention. Dr. Addison saw the white corpuscles migrating from the minute blood-vessels into the tissues outside. His observations were published in the Transactions of the Provincial Medical and Surgical Association of 1843 and 1844*, which can probably be only found in some of the large medical and scientific libraries in the United Kingdom or in the United States, so that I am unable to give any details of his work. His discovery was fully confirmed in 1846 by Dr. Augustus Waller, an English physiologist, who watched the process of inflammation in a frog's tongue placed under the microscope. His method and description are very complete, and the illustrations give great exactness to them. The mere exposure of the tongue speedily excited inflammation, so that he had the opportunity of seeing the increased flow of blood, and the process of exudation of liquor sanguinis; and now he was able to see the white corpuscles moving slowly against the wall of the small blood-vessels, then coming to a standstill, and finally squeezing themselves through the coats of the vessels with their peculiar amœboid mode of progression, first forcing an arm through, and then, by degrees, the whole body, while the hole through which they had emerged closed

* (1.) William Addison, M.D. "Experimental and Practical Researches on the Structure and Function of Blood-corpuscles, on Inflammation, and on the Origin and Nature of Tubercle in the Lungs."—Prov. Med. Surg. Assoc. Trans., vol. xi., 1843, p. 233. (2.) "The Actual Process of Nutrition in the Living Structures demonstrated by the Microscope, and the Renewal of the Tissues and Secretions from the Blood thereby illustrated."—Op. cit., vol. xii., 1844, pp. 235–306.

again like indiarubber softened by heat. The full significance of this discovery could not be perceived at the time. The fields of physiology and pathology were still practically unexplored, and the migration or diapedesis of the blood-corpuscles could only be registered as a fact to be made use of on some future occasion. It was one of those discoveries which prove the value of the pursuit of knowledge for its own sake, the scientific worker, with far-seeing vision, looking forward to the time when facts apparently isolated, and to the untrained mind of little value, will find their connection with other facts and form a continuous chain of knowledge.

Dr. Addison's discovery was lost sight of for nearly a quarter of a century, when the migration of the white corpuscles was rediscovered by Cohnheim (1867), who studied the process of inflammation in the mesentery of a frog, and added valuable newly-observed facts to the pathology of inflammation. Now, what could impel these white corpuscles to wander out from their natural element? Were they driven by the *vis a tergo* with the blood-stream? What are these white cells? Here, however, we must leave them for a time, as a novelist sometimes leaves important characters introduced in his earlier chapters, while others occupy the scene, to bring them all together for the *dénouement* at the end.

A few words more concerning theories of disease, and I shall be able to enter on the more immediate subject of this address. The origin of fevers has at all times exercised the minds of physicians. Even up to quite a recent period, twenty years ago, there were some who maintained, and there may be still, for aught I know, some who believe, that certain fevers—typhus and typhoid, for instance—could be generated *de novo*, and without infection, direct or indirect, from an individual suffering from fever, by privation, fatigue, dirt, and overcrowding. This is the doctrine of heterogenesis from the clinical side. On the other hand, there were some, even as long as fifty years ago, who believed that a specific poison was handed down by descent from a similar poison, and was received into the system, where it multiplied and "fermented," and was finally cast out by a crisis. It was the old doctrine of crudity, coction, crisis, and despumation a little farther advanced. The theory of an impure state of the blood gave place to one more definite—namely, that of a specific organic body as the poisoning agent—but it was understood that this poison was spread, and infected human beings, by means of the atmosphere. I am indebted to Dr. Aitken's work on medicine for the fact that in 1838 Boehm attributed cholera to the presence of a fungus affecting the intestinal epithelium, and he gave drawings of microfungi which he found. These

could hardly have been the true microbes of cholera, but the idea of a vegetable parasite was there. In 1840 Henle published a remarkable paper, "On Contagion and Miasma, and Miasmatic Contagious Diseases," in which he "concluded, from theoretical grounds, that contagious diseases must be caused by organized contagia, which he considered were probably of the nature of low vegetable organisms. He further added that these parasites need not necessarily be so small that the magnifying-power of our microscopes was not sufficient to demonstrate them, but perhaps they escaped observation only because of the difficulty of distinguishing them from the surrounding tissues—a supposition which has been brilliantly confirmed by the discovery of the tubercle-bacillus." —(Fehleisen.) This was the real beginning of the bacterial or ferment theory of disease. As already stated, however, the origin of fevers *de novo* was maintained by some as late as thirty years after this, and the extraordinary sporadic occurrence of fevers under circumstances which appeared to preclude the possibility of infection in the usual sense seemed to lend confirmation to this view.

Before the theories started by Henle were entertained, the word "parasite," in connection with disease affecting the human species, was understood to apply to distinctly animal organisms, such as entozoa; later the term was extended to the fungi of certain diseases of the skin and hair, such as ringworm. The word "fermentation" had long been in use to denote the febrile process. What was called the effervescence or ebullition of the blood, by which terms the older physicians characterized its condition during the continuance of the high temperature in fevers, before the crisis, was believed to present some analogy with the process of fermentation in vinous or malt liquors, although the exact nature of alcoholic fermentation was still known to or suspected by but few. In 1842 Dr. William Farr introduced the word "zymotic" to designate the poison of specific fevers; but he did not consider the febrile process to be absolutely identical with ordinary fermentation, and even then it was held that the ferment-producing body was or might be some nitrogenous organic substance without more exact definition. While physicians were seeking for the poison of fevers, chemists were endeavouring to discover the cause of alcoholic fermentation. The vegetable nature of ferments was ascertained and asserted by Cagnard de Latour in 1837, but the fact had not obtained acceptance by the scientific world. The theory that ferments were due to an organized body was definitely settled by the researches of M. Pasteur (1857–60), who, in 1857, described the little globules or short segments of the ferment of lactic acid, and in 1858 those of alcoholic fermentation, and came

to the conclusion that there were specific ferments, each producing its own specific fermentation.

The teachings of M. Pasteur created a new interest in the search for the ferments of the zymotic fevers. In 1850 Rayer discovered little filiform bodies in the blood of animals which had died from anthrax or charbon. This discovery slept until 1863, when Davaine inoculated rabbits with blood containing these filiform bodies, with the result that they died of anthrax. The little cylindrical rods of butyric fermentation were described by Pasteur in 1861, and Davaine says that it was owing to Pasteur's demonstration of the connection between these "corpuscles" and the butyric fermentation that he conceived the idea that anthrax might be caused by the corpuscles seen in the blood in anthrax. Thus slowly, by years of clinical observation, by years of chemical, microscopical, and botanical researches, the *fons et origo mali* was found. Physicians, chemists, and biologists had, each in their own department and working in their own way, contributed something to this result. And now the search for specific bacteria in disease may be said to have fairly begun. Hitherto the efforts of the believers in the parasitic—*i.e.*, bacterial—origin of diseases to discover the microbes had been rendered futile by difficulties connected with the means of research. The habits, if I may use the term, of the bacteria were unknown; their behaviour to chemical reagents—in short, the whole scientific method connected with the investigation of their life-history and microscopical demonstration—had to be built up almost from the beginning, and errors unavoidable in the investigation of a new and difficult science had to be eliminated. These difficulties have in the case of many of the specific bacteria been overcome, while other bacteria whose existence was before strongly suspected are being constantly added to the list of those that are known. Cohn showed that bacteria arose in solutions of decaying animal matter, and placed them among the vegetable organisms. But the admission of bacteria to a place in the natural kingdoms as independent living organisms was not to take place without a war of words and scientific tests.

As it was believed by clinical physicians that fevers could be generated *de novo* in an unhygienic environment, so more than one distinguished biologist has argued that bacteria may arise by natural laws and reactions in solutions of organic matter. This opens up the question of so-called spontaneous generation in general; and the subject did not escape the attention of M. Pasteur, who, in 1860–61, after carefully-conducted experiments, came to the conclusion that "all organized productions of infusions take their origin from corpuscles which exist in suspension in the air." He says in

another place (1860), "What would be most desirable would be to conduct these studies far enough to prepare the way for a serious investigation as to the origin of various diseases." M. Pasteur's experiments and words such as I have just quoted set Davaine thinking about the connection between the rods seen by Rayer in anthrax and the causation of that disease, and had for immediate effect the experiments in antiseptic surgery by Lister, which have been followed by such brilliant results. We are thus brought back to the views of Hippocrates and his successors as to the πνεῦμα or *spiritus* in the air with which we inhale the origin of disease, as well as the principle of life. We have here, too, the explanation of what Sydenham, in the seventeenth century, termed the "latent and *inexplicable* alteration of the air infecting the bodies of men."

The views of Bastian may be given as those of one of the most recent supporters of the doctrine of heterogenesis. In a solution containing organic matter he describes the aggregation of minute portions of protoplasm—the plastide particles—in a film—the proligerous pellicle; and he maintains that "bacteria are produced as constantly in a solution of colloidal matter as crystals are produced in a solution containing crystallizable matter." He says, in his conclusions, "Both observation and experiment unmistakably testify to the fact that 'living' matter is constantly being formed *de novo* in obedience to the same laws and tendencies as those which determine all the most simple chemical combinations, the qualities which we summarise under the word 'life' being in all cases due to the combined molecular actions and properties of the aggregate which displays them, just as the properties which we include under the word 'magnetism' are due to particular modes of collocation which have been assumed by the molecules of iron." Bastian, however, neglected to sterilise his flasks by passing them through the flame, and the omission was sufficient to discredit his conclusions with the scientific world. The balance of scientific opinion at the present day is very largely in favour of biogenesis as applied to the origin of bacteria, as well as to all forms of life; indeed, the doctrine of *omnis cellulæ cellula* is all but universally accepted. Davies (quoted by Hirsch) says, "I would as soon believe in the spontaneous generation of human beings as I would in the spontaneous generation of typhus."

The real discoverer of bacteria was Leeuwenhoeck, of Delft, born A.D. 1632. Without entering into any detailed description of bacteria, which may be found in any of the systematic works on the subject, it will be necessary to give an outline of their general characteristics in order to the better understanding of the manner in which they settle and multiply

in the bodies of men and animals, and of their relation to disease and its cure.

The word "bacterium," the latinised form of *βακτήριον*, and meaning a staff, refers to the appearance under the microscope of one division of micro-organisms, from which the name has been distributed to designate these small beings in general. The term "microbe," used by the French, indicates a small living thing. They have been alternately classed as animals and as plants. Ehrenberg, in his work on infusion-animalcules, published in 1838, described them as animal forms, their power of movement, as he says expressly, leading him to place them in the animal kingdom. Under the microscope some forms are seen to dart across the field with very rapid movements; others have spiral, corkscrew, or vacillating or undulatory motion. Cocci have molecular or "Brownian" movements. Many kinds of bacteria are motionless. The exact place of bacteria in a biological classification may be held to be still undetermined. They have been placed among the fungi, inasmuch as bacteria consist of vegetable cells destitute of chlorophyll, and they have other characteristics of fungi. Other observers consider them as algæ, from the fact that some species do contain chlorophyll. Looking on them as plant-forms, perhaps the safest classification is that which refers them to the Thallophyta, in which Sachs places them. Other biologists place them in a separate order, which they term the Protista, to be considered as between the animal and vegetable kingdoms. At the same time, as de Bary says, "it is merely a matter of convention in the case of these simple organisms where and how we shall draw the line between the vegetable and animal kingdoms."

Bacteria consist of cells which are, so far as is known, destitute of nuclei. In form the cells are globular or ovoid, or elongated as cylindrical or spindle-shaped rods. The globular and rod-shaped forms have mostly a diameter of ·001 of a millimetre, or about $\frac{1}{25400}$in. The length of the rods is from two to four times the transverse diameter. Chemically the cells are composed of protein or mycoprotein, and have a distinct cell-wall, which possesses distinct physical and chemical properties from those of the cell-contents.

Various classifications have been made. The classification of bacteria hitherto most commonly followed is that of Cohn, who takes the form of the bacteria as the basis. He gives four classes: 1, Spherobacteria, globular; 2, Microbacteria, short rods; 3, Desmobacteria, long rods; 4, Spirobacteria, spirals.

This brings us to the terms used in describing bacteria. The globular cells are called cocci, from *κόκκος*, a berry, and from which, again, we have micrococcus and macrococcus.

Two cocci attached to each other are spoken of as a diplococcus, while several cocci attached to each other in the form of a chain are called streptococcus, from στρέπτος, a chain. Then there is the vibrio, or bentrod; the spirillum, a corkscrew form; bacillus, a long thin rod, &c.

Bacteria multiply by fission and by spores, or by cells which act as spores. From their mode of reproduction by fission they are called *schizomycetes* or fission-fungi.

Bacteria require for their nutrition nitrogen, carbon, potassium, sodium, and phosphoric acid, while water is necessary as a medium for the changes operated by them. Their food is obtained from organic compounds, which they have the faculty of splitting up, but they also grow in solutions of tartrate and acetate of ammonia. Some require the presence of free oxygen; hence Pasteur makes two great divisions of bacteria into (1) aërobic, and (2) anaërobic. Their growth is affected by the soil in which they happen to be planted; also by temperature, by contact with oxygen, &c.; in other words, by their environment. Thus the bacillus of anthrax and the micrococcus of fowl-cholera, so malignant under ordinary circumstances, have been rendered harmless by cultivation in neutralised chicken-broth with a supply of oxygen and in a heightened temperature; or, as some assert, through the action of the heightened temperature alone. Just as human beings and animals may become stunted and deformed by starvation and want of light and warmth, so may bacteria become altered in form, and exhibit a sickly growth; or, on the other hand, with suitable food and other accessories they may grow luxuriantly. We find similar phenomena in the higher plants. "Bishop Heber mentions that in the Botanical Gardens at Calcutta he saw a wretched little oak kept alive with difficulty, under a sky and in a temperature so perpetually stimulating that no time was allowed it to shed its leaves, or to recruit its powers by hibernation."* Bacteria which grow in living bodies are termed parasites; those growing in dead bodies or decaying organic matter are called saprophytes. That fungi can be parasitic in living bodies we have a striking example in the Cordiceps, which grows at the expense of the caterpillar which it infests, filling the body with its mycelium, and causing the death of the animal. Some bacteria—as anthrax, for example—can live and vegetate either as parasites or as saprophytes; and, further, they can live in decaying vegetable matter, such as potatoes, and this is a special source of danger to animals, which are thus liable to become infected by their vegetable food. They have distinct preferences as to their host, resembling in this respect many

* "Geograph. Distrib. of Plants." Relig. Tract Society.

animal parasites. Age influences the predisposition of the host. Young plants are more susceptible to the attack of fungi than older ones; and we all know how much more prone children are to catch scarlatina, and measles, and whooping-cough than adults, and how much more liable they are to be affected with animal parasites. Again, as to preferences, in a consumptive family all the boys may escape and the girls become consumptive, or *vice versâ*, or all the members of a family but one may escape. So, during an epidemic of cholera or of typhus many individuals may be exposed to infection, but the bacteria select by preference those whose tissues are weakened, and so predisposed for their reception, or which are unable to resist the invasion. Others, again, accommodate themselves in various species of host, as the tubercle bacillus for instance, which can live in man, monkeys, cattle, fowls, &c., just as the common mistletoe is able to graft itself on trees so widely different as the apple-tree, the willow, the oak, and the fir. Bacteria have also preferences as to the part or tissue of their host, being found in that part in which the conditions are most favourable to their life and growth. The bacillus of cholera selects the intestines, the spirillum of relapsing fever is found in the blood. In the same way animal parasites choose their home in their host. The *Trichina spiralis*, being introduced into the intestinal canal, bores its way into the spaces between the fibres of the muscles, while the liver-fluke finds out the channels leading to the liver, where it sets up its home for the time being. Bacteria obtain entrance to the body with the air that we breathe, with our food, and also through wounds.

And now we have to consider, in what way can the presence of these minute organisms cause disease? First, they act as foreign bodies. It is an axiom in surgery that the presence of a foreign body is sufficient to produce inflammation. A familiar example of this is the inflammation caused by a grain of sand in the eye. Inflammation is necessary, however inconvenient to the individual, and its use we shall see presently. As parasites, bacteria of course live at the expense of the tissue in which they grow. If they merely absorbed the juices of the part the changes effected by them would only consist in lessening the nutritive substance, and the mischief caused by them would be represented merely by the loss thus occasioned.

But they act as ferments, and it is this action especially which is the cause of disease. And here it may be as well to define what is meant by the word "ferment." A ferment is defined to be a body which causes a change of composition in organic compounds without itself forming any part of the resulting products. The alcoholic and acetous fermentations

have been known from the earliest times—that is, by their products—but the discovery of the vegetable nature of ferments began with that of the yeast-fungus by Cagnard de la Tour in 1828. It was reserved for M. Pasteur to show the exact relation of the bacterial ferments to their specific fermentations. While the term "ferment" is very commonly applied to the bacteria, or vegetable organisms causing the fermentation, it is now used by many to indicate a substance secreted by the bacteria which is the real ferment or enzyme. This substance may be separated from the bacteria producing it, and cause fermentation, or the bacteria may be destroyed while the ferment remains active.

The mode in which the enzyme, or ferment, acts is by the formation of leucomaines in the body, or ptomaines in decomposing animal substances. Our knowledge of these bodies being comparatively recent, I may be permitted to explain that ptomaines are basic bodies resembling alkaloids, developed in decaying animal matters. It may perhaps be right to call them alkaloids. The alkaloids resulting from the decomposition of albumen in the living body are called leucomaines. The poisoning caused by tainted fish, or by "high" meat, is due to ptomaines, and the cramps and spasms of cholera are believed to be caused by the ptomaines—or, perhaps rather, leucomaines—formed by the comma-bacillus in the intestines. Many of the ptomaines and leucomaines are intensely poisonous.

Epidemiology.

The discovery of bacteria as the cause of disease will doubtless in time elucidate many of the difficulties connected with epidemiology, and perhaps enable us to account for the rapid spreading of an epidemic fever, or its appearance in places far away from the presumed source of infection, or for its spontaneous disappearance. There is, perhaps, no question in connection with the infective fevers of greater interest or importance than that of their mode of spreading as epidemics. The occurrence of cholera in India, for instance, is justly regarded with alarm throughout Europe and America, for with the constant travel and commerce the bacillus is sure to find its way westward and northward. Hitherto the knowledge we have had of epidemics has been chiefly confined to the history of their outbreak and of their line of march, and of the fatalities occasioned by them, while as to the occurrence of sporadic cases of disease we were thrown back on the theory of generation *de novo*. Influenza, for instance, epidemics of which have been recorded from the year 1173 up to the present time, and which are tabulated in the learned work of Hirsch, is found to travel from east to west, sometimes spread-

ing so widely as to merit the title of pandemic. Whole countries have been stricken suddenly. Thus, in the epidemic of 1836, during the month of February, influenza appeared in Saxony, Bavaria, Lower Austria, North Italy, Spain and Portugal, France, &c., and this at a time when travelling-communication was not easy or rapid. Again, it has appeared on board ships which had sailed several days previously from uninfected ports. It has occurred at all seasons and in all weathers, hot, cold, moist, and dry. We might suppose that the germs were blown by the wind like an army of locusts, and such a theory may perhaps hold good for some diseases; but influenza has travelled from east to west during a westerly wind. Can it be carried by birds? This might seem a far-fetched idea, but, without advancing it seriously, the theory is not quite unreasonable.

In his experiments on fowl-cholera M. Pasteur showed that the microbe which produced the disease, if introduced into a guinea-pig, caused merely a local abscess, perfectly closed in by what is called in pathology a pyogenic membrane. The guinea-pigs affected suffered in no way in their general health. The abscess opened of itself, closed again, and the part healed perfectly. But fowls and rabbits living in the same coop or yard as these guinea-pigs were liable to be infected with the disease, which speedily proved fatal to them. M. Pasteur remarks, "An observer of these facts, ignorant of the line of descent of the microbe in this instance, would be astonished to see fowls and rabbits decimated, and might believe in the spontaneous origin of the disease, for he would be far from supposing that it had had its origin in the healthy guinea-pigs, especially if he knew that they were subject to the same affection." He says, further, "How many mysteries in the history of contagions will one day be solved in a much simpler manner than that which I have just mentioned!" Thus the germs of diseases fatal to one species of animals may be carried in the healthy bodies of a different species.

As illustrating some of these mysteries, let us take the course of an epidemic of cholera. The onset of the epidemic is often sudden, and the disease quickly spreads, becoming general in a city or county, but curiously sparing certain localities, even some reputed to be unhealthy. At the height of the epidemic the majority of those attacked die. By degrees the disease declines, both as to the number affected and to the severity of the symptoms, and now there is a great number of recoveries and the disease disappears. Sometimes it returns, however, as if capriciously, raging with quite as much violence as during the former visitation, and again declines and disappears. I do not mean to say that all epidemics follow this course, but that the invasion of cholera

will illustrate some of the peculiarities of the visitation of epidemic disease.

Questions will arise as to why the disease should be so much more fatal during the middle or height of the epidemic than toward the end. Bearing on this question is the fact that certain bacteria may, under special conditions, develope intense virulency. Pasteur found that the virulence of rabies became greatly intensified by passing the virus through a series of rabbits; and in swine-plague, if the microbe is inoculated into a pigeon and from this passed through a second pigeon, and from the second to a third, and so on, the microbe became "acclimatised" in the pigeon, "and the blood of the later pigeons in the series proved much more virulent to the pig than even the most infective products from a pig which had died of the so-called spontaneous swine-plague." Other conditions by which the virus may be modified or destroyed are temperature and the admixture of chemical solutions with the nutrient material, while the virus may be altered according as the bacteria grow in the living body, or out of the body on decomposing matters—that is, as parasites or saprophytes. The bacillus of cholera has been cultivated in gelatine and on potatoes by Koch, and he is of opinion that it can reproduce itself and multiply in decaying animal matters outside the human body. It certainly would appear that the germs of cholera, on being transplanted to a district hitherto unaffected, develope intense virulence. While we are not in a position to give a categorical answer to the question proposed, we see what circumstances *might* happen to a bacterium by which its virulent properties may be preserved or even intensified. Each specific pathogenic bacterium has its own conditions of temperature, moisture, and nutrient substratum, in which it best flourishes and produces disease, and future researches will doubtless determine what those conditions are for each bacterium outside of the laboratories of investigators. One fact, however, has been well established with regard to zymotic—that is, bacterial—diseases—namely, that they have a preference for individuals whose bodies are in a low state of vitality—a fact known long before the discovery of bacteria.

I referred at a former part of this address to the supposed influence of the seasons in the causation of certain epidemic diseases. This is expressed at the present day by the term "epidemic constitution" of the season or year. One year we find pneumonia prevalent, another year pleurisy, another typhoid. With our present knowledge of bacteriology we may explain the occurrence of particular epidemic constitutions by the fact that specific bacteria happen to find at such times the temperature, moisture, and nutrient material—that is, the human body—under fit conditions for their development; and

as long as these conditions exist, so long will they flourish and the diseases continue.

Another question arises—namely, Why should an epidemic finally disappear? This brings us to the subject of the attenuation of bacterial virus. It may perhaps be possible to stamp out an epidemic on its first appearance, and before it has spread, by vigorous hygienic measures; but when it has obtained a firm hold in a densely-populated city stamping out becomes practically impossible. Such diseases as cholera, relapsing fever, and typhus rage like a wide-spreading fire, and are more difficult to extinguish or limit. A fire will, of course, become extinguished when the inflammable material is all consumed; but epidemics decline spontaneously without attacking all who might be susceptible. I use the word "spontaneously" provisionally only. It would be difficult to believe that the subsidence of the epidemic was due to increased energy in sanitation, for, to all appearances, the conditions may still exist in many parts of the large towns which are usually held to invite zymotic disease.

The word "attenuation," as applied to the virus of an infectious disease, is understood to mean that the germ or bacterium causing it exists in such a condition that it only produces a poison of mild variety, or that its poisonous properties have been totally extinguished. The most notable example of attenuation is that of the virus of small-pox by inoculation. Inoculation for small-pox was practised in India and the East for centuries before it was known in Western Europe. Introduced into the body in this way the disease was certainly attenuated; but, several deaths having occurred from the inoculated disease, and vaccination with cow-pox lymph being found to be safe, inoculation was made illegal by Act of Parliament in 1841. It is more than probable that many deaths used to occur from inoculation owing to the want of proper precautions in performing the operation, the necessity for which precautions was not then understood. But, notwithstanding the occasionally fatal result of inoculation, it is established that in the great majority of cases the disease was rendered milder than when contracted in the ordinary way. This was an instance of attenuation before the nature of the virus was understood. M. Pasteur, having observed that fowl-cholera in the natural state is not always fatal, concluded that the virus occurred in variable degrees of intensity; and he noted also that fowls which recovered were not again, or, at least, rarely, subject to a second attack. It occurred to M. Pasteur that by artificially attenuating the virus the disease might be rendered milder. By making successive cultures even of the most virulent micrococcus in chicken-broth at prolonged intervals, he was able to produce a true "vaccinal"

virus, which being inoculated into fowls not only does not kill but actually protects from the fatal form of the disease. M. Pasteur communicated these results to the Academy in 1880.

Anthrax, also, has been attenuated by M. Pasteur so that he was able to produce virus of different degrees of virulence—a virus which produced anthrax in sheep, cows, and horses, but did not cause death, while it was still fatal to guinea-pigs and rabbits, and, finally, a very attenuated, virus, which had lost its virulence for guinea-pigs and rabbits, and protected them against an attack. Further, he was able to keep up the artificial cultivation of the microbes, now rendered inoffensive. But an important exception must be made in the case of guinea-pigs, for the attenuated virus was found to be fatal to a guinea-pig one day old, and the virulence could again be restored by inoculating a series of guinea-pigs, until in the end it was strong enough to kill sheep, and M. Pasteur does not hesitate to say that it would kill even cows and horses; or, as M. Roux expresses it, the bacillus can be made to reascend the steps of virulence down which it has come, and so be rendered once more virulent. Swine-plague virus is fatal to rabbits, and the virulence increases a hundred-fold by passing it through a series of rabbits. But, according as it becomes most deadly to rabbits, it also becomes attenuated for the pig, and may be used to protect that animal from the disease.

Some of the questions regarding the cause of epidemics and contagions and their virulence or mildness are thus treated by M. Pasteur. He says, "The above facts may help to explain the appearance of these plagues. An epidemic which has been extinguished by the weakening of its virus may light up again by the strengthening of this virus under certain influences. The accounts which I have read of the spontaneous appearance of the plague appear to me to offer examples of this: witness the plague at Benghazi in 1856–58, where the outbreak could not be traced to any origin by contagion. Plague is a virulent disease peculiar to certain countries. In all those countries its attenuated virus must exist, ready to take on its active form whenever certain conditions of climate, of famine, of poverty again appear. There are other infective diseases which appear *spontaneously* in all countries: such is the typhus of camps. Without doubt the germs of microbes, the authors of these diseases, are spread about everywhere, . . . ready to become dangerous when, under conditions of overcrowding, and of successive development on the surface of wounds in weakened bodies, or otherwise, their virulence becomes progressively strengthened. . . . What is a microscopic organism which is innocuous to man or to some particular animal? It is a being which cannot develope in our body or in

the body of that animal; but nothing proves that, if the microscopic organism penetrates into another of the thousands of species in creation, it will not take possession of it and render it diseased. Its virulence, thus strengthened by successive passages through individuals of that species, might at length attain a condition in which it would be able to attack large animals—man, or certain domestic animals. In this way new virulences and contagions may be created. I am greatly inclined to believe that in this manner have appeared in the course of ages small-pox, the plague, yellow-fever, &c., and that owing to phenomena of this kind certain great epidemics appear, such as typhus, just mentioned."

This mention of the subject of attenuation and vaccination would be incomplete without some notice of M. Pasteur's method of treating hydrophobia, which occurs in the dog as rabies. The natural disease in the dog might take weeks or months to develope. This length of time was practically prohibitive to the experimenter. Judging from the symptoms that the virus would be found chiefly in the central nervous system, he inoculated the brain of rabbits with a portion of the spinal marrow of a dog which had died of rabies, and, passing the virus from rabbit to rabbit, a virus was obtained infinitely more virulent than that procured from the original source—*i.e.*, the diseased dog. By inoculating the virus directly into the brain-membranes the development or incubation of the disease was shortened. It will give some idea of the time and patience consumed in these investigations if I mention that the stage of incubation in the first rabbit was fifteen days. After twenty to twenty-five passages from rabbit to rabbit the incubation-stage became shortened to eight days. This length of incubation-stage was maintained for a new period of twenty to twenty-five passages, when the duration of incubation became lessened to seven days, which was maintained for a series of ninety new passages of virus from rabbit to rabbit. After this the incubation-period is six days, when the virus attains its maximum intensity and becomes "fixed." By suspending portions of the spinal cord in dry air from one to fourteen days they were found to have lost their virulence in proportion to the time they had been exposed. By very long exposure their virulence became extinct, so that rabbits inoculated with the most attenuated cords—that is, of fourteen days' exposure—were found to be unaffected with the disease. It was thus possible to procure a virus of any desired strength. Dogs inoculated at first with the fourteen-day cord, on the next day with the thirteen-day cord, next day with the twelve-day cord, and so on, were found to bear inoculation with unattenuated virus, and to be fully protected against rabies, whether inoculated with virulent matter or bitten by

a rabid animal. Dogs and animals so protected are said to have been rendered "refractory" to the virus. M. Pasteur now conceived the idea that if dogs had been bitten by rabid dogs the disease already in the system might be attacked and conquered, and the dogs saved, by inoculating portions of the virus in the same manner. The result bore out his anticipations. Dogs which were bitten and inoculated recovered, others not so protected died. What if this method could prevent hydrophobia in man? On the 6th July, 1885, there was brought unexpectedly to the laboratory of M. Pasteur a boy named Joseph Meister, aged nine years. The boy had been bitten in several places—on the hands, on the legs and thighs, so that he walked with difficulty. The same evening M. Pasteur began the treatment by inoculations, continuing them for twelve days, until he had used a virus only one day old. The result was that this boy, who had the seeds of a fatal disease in his system, recovered perfectly without having suffered beyond the mere wounds.

Since the memorable date on which Joseph Meister was treated about 150 persons have come each month to the Pasteur Institute for antirabic inoculations. Up to the 21st March, 1889, 6,870 persons have been treated there, many of them very severely wounded. The mortality of persons so treated has been 1 per cent., the usual mortality after the bites of rabid dogs being 15 per cent. The success in these inoculations is due to the slowness with which the virus after a bite usually reaches the nervous centres. In man the average incubation-stage is six or seven weeks. It may, of course, be shorter or much longer. But should the virus reach the brain and the spinal cord very quickly, by means of the blood-stream, inoculative treatment may be too late. Such cases constitute the 1 per cent. of those treated which end fatally, as in bites about the face. In severe cases the treatment has to be very active, spinal cords a few days old being used almost at once, instead of beginning with cords of fourteen days. And here I let M. Roux, M. Pasteur's collaborator, use his own words. He says, "The most remarkable point, however, in the whole discovery of this preventive inoculation against rabies is that it has been carried out, the virus itself being still unknown. Not only do we not know how to cultivate it outside the body, but in allowing it really to be a microbe we can do so by analogy, for as yet no one has been able to isolate it. Notwithstanding this, however, it is daily being attenuated, and made to pass through the various stages of virulence. Unable to cultivate the organism artificially in flasks and tubes, M. Pasteur has been obliged to do so in the rabbit; and so easily and with such perfect regularity are these cultivations in the living animal performed that they are ready

each day for use in the inoculations at a specified time, and in the condition of genuinely pure cultivations. There is no stronger example of the power of the experimental method as applied to medical matters than this one of the prevention of a malady the absolute virus of which is still obscure." Several antirabic institutions have now been established throughout Europe and America. The United Kingdom has none, although about fifty British subjects have been treated annually in the Paris Institute since 1886. The restrictions as to vivisection, which in experiments on animals are painlessly conducted, have not only rendered us dependent on Continental countries for advances in biological and therapeutical science, but for the care and treatment of such British subjects as may be suffering from a highly dangerous malady. It is within the range of possibility that a parallel method of treatment may be adopted for other infectious diseases in the human subject. Should this come to pass it remains to be seen whether a false sentimentality, which resists merciful experiments by which thousands of lives of animals, as well as of human beings, may be saved, while it allows pigeon-shooting and coursing to be practised as *sports*, will continue to triumph over true humanity and common-sense.

Before considering the bacteria of specific diseases we will inquire—(1) How it is possible for the body to resist an attack of bacteria; (2) How does spontaneous cure of fevers occur? (3) How does vaccination with attenuated virus prevent or cure bacterial disease?

(1.) In answer to the first question, we have now to resume our acquaintance with the white blood-corpuscles, which, as we saw, play an important part in the process of inflammation. What are these white corpuscles? In 1883 Dr. Elias Metschnikoff published some important observations on the intracellular digestion of invertebrates, showing, from his own researches and from those of other biologists, that the amœboid cells of the mesoderm are capable of ingesting and absorbing albuminoid particles. By taking *function* as the standpoint for observation, instead of merely considering *form*, he traced the white blood-corpuscle of vertebrates to the same phylogenesis or common origin, as a class or race, as the amœboid cells of the mesoderm in the Metazoa. It is necessary to call to mind the signification of the terms "ectoderm," "endoderm," and "mesoderm," which, of course, mean literally outer layer, inner layer, and middle layer respectively. In the development of the ovum the cells of the blastoderm or germ divide into two layers, the ectoderm and the endoderm. In the orders above Cœlenterata a middle layer of cells appears, probably derived from the other two. This is termed the

mesoderm, and in it are found the blood-vessels, muscles, internal skeleton, and the excretory organs. What we have now to note is that to the mesoderm belongs the vascular system.

The mode in which the Amœba envelopes and disintegrates its food gives an example of intracellular digestion. This is the mode of nutrition in the Protozoa, whether singly or aggregated together in colonies. In Plumularia the *ectoderm* cells are able to take up foreign particles, and to eat up dying or dead portions of the animal or colony to which they belong. In the larvæ of the Actinias also the *ectoderm* cells have the faculty of ingesting solid food. But already a differentiation of function begins to be observed, and at a later stage of development the number of foreign particles in the ectoderm cells becomes much smaller. The function of intracellular digestion, we shall find, becomes the hereditary property of the amœboid cells of the mesoderm, and in these we should expect to find it in vertebrate animals if it existed in them. These cells have the property of being able to wander about in the body of the animal (as observed by Metschnikoff in Phyllirhoe, a transparent mollusc). They devour all dead or dying matter. In the case of large masses to be eaten, or foreign particles to be removed, the amœboid cells join their forces, becoming fused together in cell-masses termed plasmodia, which are equivalent to giant cells; or the individuals remain distinct, but swarm together in large numbers to the attack. They have a power of selection, eating some objects presented to them and refusing others. Bacteria are attacked and ingested by them, but occasionally the wandering amœboid cells are killed by the bacteria. These cells thus guard the body of the animal to the best of their power against harmful substances, while they, in destroying foreign or dead matters, are simply feeding, as I surmise, primarily for their own individual nutrition as independent cell-animals, secondarily for the nutrition of the colony of cells, or animal, of which they form a part. Metschnikoff calls them phagocytes, or eating-cells. Thus, in the lowest animal-forms all the cells are amœboid, and all are phagocytes; but as we ascend in the scale we find the cells becoming differentiated, some losing the digestive power, while those of the mesoderm retain it.

Following up this line of inquiry, M. Metschnikoff has ascertained the existence of phagocytes in the mesoderm of vertebrates. These are the white blood-corpuscles. The power of these leucocytes to wander outside of the blood-vessels has already been mentioned.

When the tails of tadpoles are undergoing absorption, amœboid cells in large numbers may be seen surrounding the muscles and nerve-fibres, which they gradually devour, and

portions of nerve and muscle may be seen in their interior, where they undergo a process of digestion. When a fully-gorged phagocyte dies it is immediately devoured by another.

Parasitic bacteria being injected into the mouse, the white blood-corpuscles were seen to contain bacteria. Wherever there is irritation causing death or disease of a part, or a foreign body liable to be injurious to the system, the phagocytes collect to remove the dead tissues or the foreign body. Thus we have within our bodies an army of soldier-cells ready to repel invasion, and in the case of bacteria frequently with success. The prophylactic function of the amœboid cells is shown by a very interesting discovery of M. Metschnikoff of their behaviour in the Daphnia when it is attacked by a yeast-like fungus. The Daphnia being transparent, he was able to see these cells collecting and investing the spores, which they digested and rendered innocuous.

Here we see one way in which the body may resist an attack of zymotic disease. Sometimes, however, the spores were able to overpower and kill the leucocytes, causing the death of the animal. In the septicæmia of mice the white blood-corpuscles endeavour to destroy the bacilli. They take them up into their interior; but they find themselves in the position of the husbandman who cherished a snake in his bosom. Koch says, "The bacilli multiply very quickly in the cell, which they burst and destroy, and are then taken up by other leucocytes, only to work the same ruin, so that in a short time the majority of the white blood-corpuscles are occupied by bacilli."

(2.) How does spontaneous cure of fevers occur? It has been mentioned that the growth of many bacteria may be arrested by introducing certain chemical solutions into the medium in which they are growing. The properties of iodine, carbolic acid, and corrosive sublimate are well known as being inimical to the life of bacteria. There are, of course, very many other chemical germicides. It has been found that certain bacteria form chemical products in their own food-material which are poisonous to themselves and arrest their growth. Thus the bacillus or micrococcus which causes lactic-acid fermentation becomes poisoned by the lactic acid formed, and the growth of the microbe ceases, although the nutrient material is not exhausted. There is some reason to believe that in several diseases, at least, a chemical substance is formed in the blood by the bacteria, which substance, when in sufficient quantity, stops the further growth of the bacteria, or causes their death—that is, if the individual survive long enough. This would, perhaps, correspond to the crisis of the disease. If the poison of the disease have not too deeply impaired the vital powers the individual recovers; in the con-

trary case, as in malignant scarlatina and malignant cholera, he dies.

(3.) The answer to the question as to the cure or prevention of a zymotic disease by vaccinating with attenuated virus may now be perceived. On such theories or facts is founded M. Pasteur's treatment of hydrophobia; and it is claimed that anthrax, typhoid, and septicæmia can be prevented by injecting into the blood some of their poisonous products. The presence of these substances in the blood alters it in such a way as to render it an unfit soil for the growth of the respective bacteria. The white cells do not always at first take up virulent bacteria, but sometimes withdraw from them; but they can gradually become accustomed to some poisonous bacteria, and are able to devour and digest them if they are first fed with the attenuated virus.

We will now glance at a few of the specific bacteria. The first microbe discovered as the cause of disease was, as already mentioned, the bacillus of anthrax. Its life-history is therefore invested with peculiar interest, for the demonstration of its presence and of its infecting-power was immediately followed by a search for specific bacteria in other diseases.

Bacillus anthracis is interesting on its own account, for it is one of the most malignant of the bacteria, and is capable of retaining its virulence under the most varied circumstances. It can grow in living matter, in dead matter, animal or vegetable. It may preserve its vitality after being frozen in a fluid at $-110°$ C, and the spores may be capable of germination after being boiled for from fifteen minutes to an hour. M. Pasteur found the germs capable of development after they had been kept twenty-two years. Its spores defy the solvent power of the gastric juice. It is capable of attacking rodents, ruminants, omnivora, carnivora, birds, and even batrachians and reptiles under certain conditions of temperature. Mice and guinea-pigs die in from twenty-four to forty-eight hours after infection with the minutest quantity of virus, and if a drop of blood be examined anthrax rods will be found, so rapid is the growth of the microbe. Man does not escape: anthrax, or charbon, in man is known as woolsorters' disease. The spot which it attacks immediately developes a pustule which is well characterized by the term "malignant pustule." We have here a striking example of a vicious heredity; but, on the other hand, we have a remarkable instance of the manner in which a vicious strain may be modified, and even totally extinguished, by a favourable environment, for this virulent bacillus may be so attenuated by cultivation in mild nutrient media as to become harmless even to animals ordinarily the most susceptible, such as mice and guinea-pigs.

This was not only proved by Pasteur, but the experiment led to inoculation with attenuated virus as a protection against the disease. From 1882 to 1888 there were 1,700,000 sheep vaccinated against anthrax, with a mortality of 0·85 per cent. The mortality of sheep in anthrax districts has gone down from 10 per cent. to less than 1 per cent., while cattle are also protected by vaccination. M. Roux tells us that insurance companies insert a clause in their agreements by which protective inoculation is rendered compulsory. Anthrax might enter the body of a man through a wound, a scratch on the hands in wool-sorting, or the spores might get into the mouth with dust or with food, and so find their way into the stomach and intestinal tract.

The bacillus of tuberculosis, or consumption, was discovered by Dr. Robert Koch. It is one which in all probability may be conveyed to human beings from certain of the lower animals. The milk of cows suffering from tubercle of the udder contains bacilli which can infect animals, and it has been suggested by a distinguished pathologist that such milk may be a cause of tubercular disease of the abdominal glands in hand-fed children.

At the recent French Congress on Tuberculosis the conclusion was arrived at "that the disease can be transmitted to man from the lower animals by the ingestion of diseased meat and milk." In consequence of this the French Government have made the exposure of tuberculous meat for sale illegal. In the United Kingdom many high authorities have decided that the meat and milk of tuberculous cattle is dangerous to health. It will be small comfort to those who oppose vaccination by humanised lymph on the ground that a blood-poison is introduced from another individual, to know that a virulent blood-poison may be taken in with animal food. Monkeys, cattle, rabbits, guinea-pigs, fowls, and, in short, all warm-blooded animals, are susceptible to tuberculosis. Consumption was believed to be contagious in Languedoc, Spain, and Portugal, as Dr. Elliotson, writing fifty years ago, informs us, and also in Italy. In these countries the clothes of a consumptive who had died were burned or buried. The direct infectiousness of tuberculosis has been amply proved by experiments on the lower animals, and, accidentally, in the case of man. It would, of course, be impossible in one evening to review the various specific bacteria of disease. I must content myself with naming some of the diseases of which bacteria are known to be the cause, or in which full proof—that is, visual proof—of their existence may be looked for any day, as in hydrophobia. These are erysipelas, pneumonia, leprosy, diphtheria, typhus, typhoid, septicæmia or blood-poisoning, cholera, relapsing fever, two forms of ophthalmia, anthrax, tuberculosis,

whooping-cough, influenza, measles, tetanus, yellow-fever, dengue, actinomycosis, &c.; while the fevers of the lower animals are also bacterial in their origin. Many slight febrile affections usually denominated as "colds," although perhaps occurring at the height of summer, are most probably due to bacterial agency. Disease-bearing bacteria swarm around us, seeking for bodies in a weakened condition into which to enter, or awaiting their opportunity as saprophytes in moist, dark, unwholesome places, where dead organic matter offers them a resting-place.

The discovery of pathogenic bacteria is destined to effect changes which we cannot even now foresee in our quarantine laws, in our public and domestic architecture, in our cookery, in the quality of our animal food, in the breeds of our domestic animals, in our intermarriages, in the disposal of our dead, and in many other ways. Bacteriological Institutes are now being established throughout Europe and America. Their importance in relation to public health cannot be over-estimated; and in new colonies such as these of Australasia, the question of State Bacteriological Institutes is well worthy the consideration of Governments. It would seem that so much is being discovered as to the causes of sickness and the means of preventing it that disease must ultimately become rare, and, indeed, it is true that many diseases are becoming rare. But civilisation is a slow process. Disease in one class of society may affect all classes; disease in one family may affect several families. Nothing but a widespread liberal education, a socialism of knowledge, can ultimately eradicate disease.

ART. IV.—*Remarks on Pathogenic Microbes, and the Means of preventing Diseases originating in their Introduction into the System.*

By W. T. L. TRAVERS, F.L.S.

[*Read before the Wellington Philosophical Society, 4th December, 1889.*]

THE investigations of Davaine, Pasteur, Koch, Cornil and Babés, Duclaux, and others, have conclusively established that many serious diseases which affect man and the most valuable of his domestic animals, owe their origin to the introduction into their bodies of minute vegetable organisms, now known under the generic name of "microbes." So long ago as 1860 I ventured, in a letter addressed to Sir Joseph Hooker, to suggest that certain symptoms in febrile diseases indicated the

presence in the blood of something in the nature of a ferment, which I then supposed to be fungoid, those symptoms presenting, as it appeared to me, considerable analogy to the results produced by ferments upon saccharine solutions. Sir Joseph did not take any notice of this part of my letter, the bulk of which had reference to questions relating to the botany of New Zealand, and there, so far as I was concerned, the matter ended; and I only mention this now in order to show why I take so much interest in the important investigations to which I have alluded.

It must be apparent that the results established by these investigations render it of the utmost importance that there should be a more general knowledge than now exists, of the nature of the minute organisms in question, of their mode of action on man and the domestic animals, and of the circumstances which lead to or favour their introduction into the body, more especially, as regards the latter point, with a view to the adoption of all possible measures to prevent it.

The first to notice the presence in the blood of the class of organisms referred to was Davaine, who, in 1850, found in that of animals which had died of splenic fever quantities of minute rods, to which he gave the name of bacteridia; but it was only in 1863, when Pasteur had discovered the part played in fermentation by some of the organisms now forming members of the class termed microbes, that Davaine was led to suppose that these bacteridia were the actual cause of the splenic fever.

This disease, commonly known by the name of anthrax, affects man as well as animals, and is one of the most deadly to which cattle and sheep especially are subject. In these animals it is generally produced by inoculation, as, for example, by the bites of flies which have fed upon the carcases of beasts that have died of the disease, or by the poison coming otherwise into contact with some accidental abrasion of the skin, or with punctures of the mucous coat of the mouth caused by the prickles of plants on which they may have fed. The period of incubation of the disease is extremely short, an ox, apparently healthy at his return from his work, having been known to exhibit symptoms of the disease soon after, and to die within an hour after exhibiting the first appearance of infection.

In order to discover why this disease was so common in some districts in France in which it had been found difficult previously to assign a cause for its spread, Pasteur carried on some experiments, with the aid of two other specialists, and found that sheep permitted to feed on grass upon which bacteridia taken from the blood of diseased animals had been intentionally spread, speedily manifested all the symptoms of

the disease, and died. The glands and tissues of the back of the throat were found to be in the condition which would naturally result from inoculation by means of wounds, slight, it might be, of the surface of the mucous membrane of the mouth, and, in order to ascertain whether this was the likely cause, grass mixed with thistles, bearded ears of barley, and other prickly forms of fodder, on which bacteridia had been scattered, was given to other sheep, the result being that mortality amongst them was rapidly induced.

Experiments were then made in order to ascertain how long the vitality of the bacteria was maintained after the death of an infected animal, and it was found that, while by far the greater number were destroyed by the putrid fermentation of the carcases of the diseased sheep, a proportion became disengaged by the gas generated during decomposition, and that these, drying up, produced spores which retained their vitality for a long period, and were so minute and light as to be capable of being transported by even the weakest currents of air.

As regards the human subject, it has been found that anthrax, appearing in the first instance in the form of malignant pustules, affects shepherds, butchers, tanners, and others who handle the flesh and skins of tainted animals, the disease usually resulting rapidly where there is any scratch or wound in the face or hand.

Instances have occurred in which the disease has apparently been introduced into man through the mouth or lungs, but human beings are apparently less subject to contract it in this manner than the herbivora, for the flesh of animals killed after the microbe has become fully developed in the blood is often eaten with impunity in the farmhouses on properties on which the disease has been prevalent. It may, however, be said that in this case the microbes are effectually destroyed by the cooking processes to which the flesh is subjected.

The important researches which were induced by and followed upon the discovery of the effects of the inoculation of sheep with *Bacillus anthracis* have, as already mentioned, clearly demonstrated that nearly if not all the most serious febrile diseases which attack man and the domestic animals have their origin in the introduction into the system of special forms of microbes.

This has been established in the cases (amongst others) of cholera, typhus, and typhoid fevers, small-pox, recurrent, yellow, scarlet, and intermittent or malarious fevers, and in croup, and also in such minor diseases as measles, whooping-cough, &c., in man, and in the cases of the rouget, or swine-fever, of glanders as affecting horses, of rabies as affecting the

dog and cat, and of fowl-cholera, and in many other diseases affecting the domestic animals.

But whilst we have a special form of microbe concerned in each of these diseases, there are general characters and modes of reproduction common to the entire class, and these have particularly to be considered in relation to the manner in which they are disseminated and to the precautions which have to be taken against infection.

The latter points, however, can only be discussed after we have acquired a knowledge of the former, and I now proceed to give such information in this respect as I have been able to gather from the works of Pasteur and others.

For some time after the discovery of these singular organisms it was matter of doubt, even in the minds of the most careful observers, whether they belonged to the animal or vegetable kingdom, many, indeed, inclining to the belief that they constituted a link connecting the two; but later and more accurate investigations have established that they are purely vegetable, and are, in effect, special forms of Algæ. The classification now recognised divides them into eleven genera, most of which have received names characteristic of their respective outward forms; and to one or other of these nearly all the specific diseases I have already referred to have been assigned.

As several of these genera, however, are polymorphic, it is not impossible that some diseases may be produced by microbes belonging to more than one genus, although the impression as yet arrived at by investigators is adverse to such a supposition.

But, however varied may be the external forms of these pathogenic organisms, they all possess certain characters in common to which I will now shortly refer.

In the first place, they all appear under the microscope as minute cells of a spherical, oval, or cylindrical shape, sometimes single, sometimes united in pairs or in articulated chains or chaplets either straight, curved, or spiral. The diameter of the largest does not exceed two micro-millimetres, and that of the smallest is not more than a fourth of that size, so that at least 500 of the former and 2,000 of the latter must be placed end to end in order to reach the length of a millimetre, requiring, in fact, a magnifying-power of from 500 to 1,000 diameters, and sometimes even a still higher power of the microscope, to make them clearly visible.

"One very common bacterium," says Trouessart, "may be found everywhere, and can be easily procured for microscopic observation, namely, *Bacterium termo*, or the microbe of impure water. This bacterium is not injurious to health, since there is no potable water in which it is not found in greater or less

quantity. In order to obtain numerous specimens it is enough to take half a glass of ordinary water from a spring or river, and to leave it for some days on a table or chimney-piece, the vessel being uncovered to allow the access of air. We may soon observe that a thin coating is formed on the surface of the water which looks like a deposit of fine dust, but which, however, consists of myriads of bacteria. If we take a drop of this water and place it under a cover-glass in order to examine it under a microscope with a magnifying-power of about 500 diameters, we shall, as soon as the instrument is properly focussed, see a really surprising spectacle.

"The whole field of the microscope is in motion: hundreds of bacteria, resembling minute transparent worms, are swimming in every direction with an undulatory motion like that of an eel or snake. Some are detached, others united in pairs, others in chains or chaplets, or cylindrical rods, which are partitioned or articulated: these are only less mature, or younger, than the first. Finally, we see a multitude of small globules which result from the rupture of the chaplets. All these forms represent the different transformations of *Bacterium termo*, or the microbe of putrefaction. Those which are dead appear as small, rigid, and immovable rods."

In all the various forms of microbe, however, each cell consists of a cellulose wall containing protoplasm. These cells, so long as they continue active, multiply by fission with enormous rapidity, precisely in the same way as in the case of ferments. When, however, the liquid upon which they subsist is dried up, the cell-wall dries also, and the protoplasm within contracts and forms a spore, which, being set free by the rupture of the wall, gives rise to fresh microbes by germination when placed under suitable conditions.

Pathogenic microbes, then, are extremely minute cells, invisible except under very high powers of the microscope, having walls composed of cellulose, enclosing particles of protoplasm, multiplying rapidly whilst active by fission, and, when no longer capable of increasing in this manner, producing spores which, on finding a suitable soil, produce a fresh crop by germination.

Microbes themselves and their spores, as well as the spores of moulds and ferments, are extremely light, and float in the atmosphere amongst the innumerable other particles of matter which reveal their presence to the naked eye by reflecting light, as may be observed when a ray passes through a narrow opening into a darkish room. Elaborate investigations have been made in Europe—chiefly in France—with a view to obtain statistical information as to the hygienic condition of the air of towns, according as it is more or less charged with these minute organisms.

The apparatus used for the purpose is so constructed as to enable the observer to collect, on thin plates of glass coated with glycerine, the particles of dust, &c., floating in the atmosphere, the collecting-plates being transferred, at fixed intervals, to the objective of a microscope in order that the collected matter may be examined. By means of this process calculations have been made in the various places of observation of the number of microbes or their spores ordinarily present in given volumes of air, and it has been found that during the damp weather of the winter months, and that part of the summer in which the increased temperature is accompanied by moisture, they are comparatively few in number, the maximum being reached in the months of April, May, and June, (answering to our months of October, November, and December,) when the summer air is hot and dry, and during cold dry weather in winter, the chief reason for the observed difference in numbers being that during the moister seasons the microbes and their spores settle on the ground, on the leaves of plants, &c., where, however, the pathogenic forms are to the full as dangerous as when floating in the atmosphere. The difference in the number of spores found by means of these observations under favourable and unfavourable conditions was considerable, the number under the former frequently reaching 35,000 in a cubic metre of air, whilst under the latter it did not exceed 7,000. But, whether we take into consideration the higher or the lower number, it is clear that the risk of infection is extremely great, especially in places where diseases originating from the introduction of these organisms into the system are known to exist.

As instances of the extreme danger resulting from such conditions I might cite the case of hospitals in which large numbers of patients formerly died in consequence of erysipelas supervening upon surgical operations, owing to the atmosphere being thickly pervaded with the microbes of that disease, and the case of whole families having been sacrificed, chiefly through ignorance, but too often through that pig-headed disregard of the results of scientific investigation which persons, otherwise intelligent, frequently display in relation to such diseases as phthisis and small-pox. Fortunately, as regards our hospitals, the disastrous results produced by erysipelas are now avoided by the use either of Guerin's protective dressing—adopted in consequence of Tyndall and Pasteur's researches into the nature of air-germs—or, as is more generally the case, of Lister's antiseptic treatment of wounds.

It will have been gathered from the foregoing remarks that the microbes of the various diseases I have already referred to—which, however, by no means exhaust the list of those that owe their origin to the action of pathogenic germs—

must often be disseminated in enormous numbers by currents of air and otherwise, in localities inhabited by persons afflicted with diseases so generated where no special arrangements are made to prevent it; and it must be apparent that we have little reason to wonder, looking to the efficiency of the natural modes of dispersion, and the facilities afforded by the structure of human beings and of herbivorous animals for their introduction into the system, at the occasional rapid spread of the more malignant of these diseases, such as small-pox, cholera, malignant typhus, &c., in places deficient in the possession of proper preventive agencies.

These agencies are of two kinds—first, such as free those who are unavoidably exposed to danger of infection from liability themselves to contract the special disease; and, second, such as are calculated to prevent the general spread of infection in places where the disease is present.

Of the first kind are vaccination, as in the case of small-pox, and inoculation with the virus of other specific diseases, so attenuated by culture as to reduce it to the condition of a vaccine. The methods by which the latter effect is produced are very interesting, and are entirely due to the wonderful perception of Pasteur, who has demonstrated their efficiency in the cases of rabies, fowl-cholera, swine-fever, and others, though no success has yet marked the efforts made in such diseases as typhoid fever, the glanders of horses, and the infectious pneumonia of horned cattle, owing to the extreme difficulty of attenuating the microbes of these diseases by culture. But success is not despaired of in these cases, and the process may in time be also applied to others of these forms of disease in man. Pending this, however, it is our clear duty to adopt measures of the second class above referred to.

The most important of these are,—first, the isolation of diseased patients, a thing which presents some difficulty in private dwellings; and, second, the immediate exposure to destructive processes of the excreta of the patients,—and when I speak of excreta I use the term in its largest sense.

Everything which has come into or which has been even liable to the chance of contact with such patients should be exposed to some treatment which has been proved to be destructive to microbes and their spores, before uninfected persons are subjected to the risk of contagion or infection, especially where the actual destruction of tainted articles, such as body-linen, bedclothes, &c., is inexpedient or impossible—as, for example, in the instance of persons who cannot afford the sacrifice. All the surfaces of the rooms in which they have lain should be subjected to similar treatment. In order to show the importance of this, Trouessart

cites the investigations of Wood and Formad, two American physicians of the highest standing, in relation to an outbreak of croup in 1881 at Ludington, a small town on the borders of Lake Michigan. The principal industries carried on there were derived from the neighbouring forests, an immense quantity of the trees of which had been sawn into planks in numerous sawpits within the area of the town. The greater portion of the town stands on a height, but one quarter is built on low marshy ground, which has been partly filled up with sawdust. In this quarter the soil is so saturated with moisture that when a small hole is dug it fills with water immediately, and consequently cellars are unknown. It was in this quarter that the epidemic broke out, and was most severe, almost all the children having been attacked by it, and not less than a third of them having actually died. When Wood and Formad began their investigations Formad went to Ludington to study the epidemic and collect materials for experiments. In all the cases of croup he found the blood full of micrococci belonging to *Micrococcus diphthericus*—some detached, others united in the form of zoogl\u0153a — that is, agglutinated in small masses, — and others, again, in the colourless corpuscles of the blood. All the organs, and especially the kidneys, were likewise filled with them. With the materials which he gathered he and Wood made experiments in cultures, and were able to inoculate rabbits with croup. These inoculations were made subcutaneously in the muscles and trachea, and were followed by the production of false membranes, the animals soon dying with all symptoms of diphtheria, and the blood proving to be full of micrococci. An examination of living animals showed that the micrococcus first attacked the colourless corpuscles, within which their vibratile motion could be observed. The corpuscles changed in appearance, the granules disappeared, and each corpuscle became so full of the micrococci that they could no longer move. In fact, the micrococci grew until they caused the rupture of the corpuscle, and then escaped in the form of an irregular mass, which constituted the zoogl\u0153a. Corpuscles filled with micrococci were found in the false membrane, in the small vessels—which they dilated and completely obliterated—and even in the marrow of the bones. Cultures made in flasks afforded important results. A comparison of the sowings made with micrococci collected at Ludington with those found in the ordinary diphtheritic angina, (then and still common at Philadelphia,) showed a great difference in the vitality and virulent properties of microbes derived from these two sources. The former multiplied rapidly and energetically, succeeding each other up to the tenth generation; while those from Philadelphia only went to the fourth or fifth generation,

and those taken from the tongue did not go beyond the third. The diphtheritic angina of Philadelphia is much less fatal than croup, and the first attemps at inoculation made by Formad and Wood produced doubtful results, precisely because they were made with the microbe of diphtheritic angina, which is an attenuated form of the microbe of croup. The organism is the same, but it is modified by the medium in which it is developed, and the vitality of artificial cultures is in direct proportion to the malignity of the disease from which the germs for sowings are derived.

I cite this instance in order to show the importance of preventive measures of all kinds. Now, the sewage system of every town should be so arranged as to insure that such parts of human and other animal excreta as usually find their way into and are carried off by the sewers should be discharged from them in a manner to insure the practical annihilation of any germs with which it is charged.

It is, as I think, the unquestionable duty of our medical men, to whom both their patients and the public naturally look for advice and instruction on these points, not merely to physic the former when they find them prostrated by diseases of the foregoing classes, but also carefully to inquire into the conditions by which they are surrounded, and to suggest such precautions in favour of those who have not yet been attacked as may be calculated to ward off danger of infection. It is also, as I think, their duty as a body to pursue investigations of the kind now being carried on in Europe in connection with the diseases in question, with a view to acquiring such a knowledge of air-germs and the microbes of earth and water as may enable them intelligently to decide on the causes of epidemics, and to recommend, with the full strength of their authority and knowledge, such steps as may tend to avert their occurrence. And it is the duty of those who are charged with the control of matters affecting the public health to obtain and act upon the advice of persons of acknowledged eminence and skill in relation to the modes to be adopted for promoting it, instead of allowing their counsels, as is unfortunately too often the case, to be presided over by the foul gods of Hocus-pocus, Hugger-mugger, and Higgledy-piggledy, with Presumptuous Ignorance as the high-priest.

Art. V.—*The Newly-opened Cave near Sumner.*

By John Meeson, B.A.

[*Read before the Philosophical Institute of Canterbury, 3rd October, 1889.*]

Plates I. and II.

In accordance with a suggestion thrown out at our last meeting that some authentic particulars should be gathered respecting the cave recently discovered on the road to Sumner, Mr. H. O. Forbes, as representing the Museum authorities, and myself, as representing this society, made a preliminary visit of inspection on the 10th September last. My coadjutor is at present very fully occupied with official work and alterations at the Museum, so it has been agreed between us that I am to write a general description of the cave and its contents, giving some account of its whereabouts, geology, and discovery, while he will supplement my remarks with notes on the bones found, some of which seem to be probably of a new species of Natatores.

I must mention that Mr. Monck, the proprietor of the ground on which the cave stands, when we introduced ourselves to him and stated our object, showed us great civility, and assisted us as far as he could in the work of investigation.

He exhibited to us everything that he had obtained from the spot in the way of bones, implements, and other remains, and very liberally handed over to us for further examination and future deposit in the Museum such of these as we found to be the most interesting. He also gave us an account of all that he had done or knew about the discovery of the cave, and offered to facilitate its more complete exploration if funds were provided for such a work and it should be thought desirable.

It is perhaps to be regretted that action was not taken in the matter, either by our society or the Museum authorities, a little earlier, because there are some questions—in connection with the date at which the moa became extinct, the people who were in the habit of hunting it, the customs, food, and utensils of the native tribes who successively used the cave as one of their dwelling-places, and the flora and fauna existing here at the period when it was known and frequented—that a careful examination of the different layers of deposit, under the direction of a scientific mind, might have materially helped to solve. It is not by any means too late yet to do something in the matter; and I am glad to say that a small sum has been already placed at the disposal of Mr. Forbes for the purpose of systematic digging and search.

Although the cave is not so large as that at Moa Point, there is one particular in which its investigation should be more profitable and interesting. The Moa Point cave, in and about which researches and excavations were carried on, under the direction of Sir Julius von Haast, during the spring of 1872, had apparently been continuously open for a very long period. The Maoris had occupied it from time immemorial as an occasional dwelling-place for their fishing-parties, and since 1839 it had evidently been used by Europeans as a shelter for cattle, or a place of temporary habitation by lime-burners, road-makers, and fishermen. Now, in contrast with this, it must be remembered that it is only a few weeks since the mouth of Monck's cave was first laid open. Forty years ago there were a good number of natives about Banks Peninsula, but they knew nothing of this cave. It had been buried a very long time, perhaps some hundreds of years, before the settling of Canterbury, or the natives in question would have had their traditions about it and its whereabouts. For exactly how many years it had been thus sealed up, secured by a mountain of loose earth and stones from the ravages of successive occupants, we at present cannot say; indeed, it is difficult to venture a conjecture on the subject, though it may be possible to do so after a thoroughly careful and intelligent examination of the cave, the deposits therein contained, and the various articles imbedded in those deposits. When it was lately broken into, therefore, the cave was, in all probability, just as it had been left on the morning when the Maori who used it went off on that fishing, hunting, or marauding excursion from which he seems never to have returned. Perhaps he was killed in fight, or perished with his frail canoe off the bold headlands to the eastward. He certainly did not die in the cave, or his skeleton would have been found there; and he just as certainly did not intend to go away without returning, for in that case he would not have left behind him such well-fashioned and, to him, valuable instruments as those which have just been found. Possibly, however, he was not shipwrecked at all, and met with no particular misadventure, but simply found that while he was absent a landslip had occurred which had so completely buried his old home that his superstition or indolence, or both combined, indisposed him to dig a fresh opening to it. There are some circumstances about the contents of the cave—more especially the kinds of wood and stone of which the tools and other articles are made—that seem to point to the fact that its last occupants were from the North Island. Perhaps they were Maoris who were in the habit of coming so far afield in their canoe or canoes every summer for the purpose of fishing, and hunting the moa. In that case it is easy to conceive that during one

of their absences in the winter the landslip occurred which, as far as they were concerned, for ever buried their habitation. Whatever explanation be accepted to account for the desertion of the cave and its contents, this remains certain: that when it was opened by the road-makers a few weeks since it was practically, except as to the decay of some perishable articles, and the amount of *débris* fallen from the roof here and there, in the same condition in which it had been hundreds of years ago. This consideration makes it the more regrettable that any digging whatever took place before some scientific man with special ability for such excavations took direction of the proceedings. Nevertheless it must be stated that Mr. Monck, in so far as he himself has carried on the work up to the present, has done his best to preserve everything of value; but he, naturally enough, did not preserve a record of the exact spot, or depth, or layer from which each article had been obtained, so that the several questions of relative time at which various deposits were made can with difficulty now be answered.

The discovery of the cave was made quite accidentally. Metal and gravel being constantly needed for the Sumner Road, Mr. Monck has for a long time allowed the stuff to be taken from one of his paddocks, as it lay in a heap, apparently having fallen down from the cliffs above. A mass of stuff, 40 yards through, was thus removed, and while clearing this away the opening of the cave was laid bare. The first person to enter was the son of the proprietor, and he when he got some distance in saw two bright eyes glaring at him from the darkness. Immediately after a cat was seen to emerge from the cave. It had entered, most likely, only the night before, through some crevice which the workmen had laid open but not observed, or possibly through some other opening from the surface of the hill into a remote part of the cave not yet explored. The latter supposition seems justified by the finding of a number of rabbit-bones upon the floor.

The geological aspect of the cave seems to be precisely similar to that of the one at Moa Point. It is a hollow in the doleritic lava formed by the washing-away of loose material between the harder rocks. There are probably many more such caves between Christchurch and Sumner, and in other parts of Banks Peninsula. We are told that the peninsula was once an island—that it was first uplifted by Titanic force from the depths below, that it was subsequently depressed about 20ft., and then raised again to about its present level. When the huge volcanic mass was depressed, the low-lying lands between Sumner and New Brighton were entirely under water. The Pacific breakers dashed against cliffs which are now miles from the sea, and everything in the shape of tufa

and other loose material which filled the exposed crevices or lay at the foot of the lava rocks was washed away. This is Sir Julius von Haast's explanation of the origin of the Moa Point Cave, and it is equally applicable in all respects to the cave now exposed. The two are only half a mile apart, the latter being the farther from Christchurch. They are similarly situated in every respect as regards elevation above and distance from the sea, and, singularly enough, each is, or was, exposed to the north-east, and protected from the north-west by a similar point of rock. This, perhaps, accounts for the formation of the caves; for the exposure of both points to the full force of the north-east breakers would facilitate the washing-out of loose rocky material; and perhaps the protection from the north-west—that is, the land side—gave these particular cave-dwellers at a subsequent time the privacy and security which, among such a people, when every man's hand was against that of his neighbour, were matters of no slight importance.

Like the Moa Point Cave, this of Monck's also consists of three chambers, but of smaller dimensions. They are, however, more equal in size to one another. As the front of the cave was covered up by loose material, so are the floors of its chambers, to the depth of how many feet it is at present difficult to say. These figures must be left for subsequent careful measurement, as also the levels of the floors, the heights of the chambers in different places, &c., and also the exact nature of the material of which the *débris* consists. This is only intended to be a preliminary notice: a much fuller and more exhaustive report, more amply satisfying curiosity, and more thoroughly examining the various interesting questions on which excavation will throw light, should certainly be undertaken as soon as can be done conveniently. Generally speaking, it may, however, be said that the *débris* covering up the bottom of the cave consists of a mixture mostly of shell, and fragments of rock and heaps of grit and scoria fallen from the roof. Here and there, however, can be clearly traced layers—in one place as many as five—of various thickness from 1in. or 2in. to 6in. or 9in. These layers are of volcanic ash at top, and the *débris* of fires (ashes of wood, dirt-beds, &c.), intercalated with a kind of silt or loess earth, apparently identical with that found here and there all round the peninsula. The second cave contained as its floor-covering nothing but a 3ft.-thick bed of this silt or loess.

As to the relics, &c., found either on the floors of the cave immediately when it was opened, or since by digging here and there in a very haphazard sort of way before the day of our visit, in so far as pertains to the numerous bones, whether of fish, or bird, or mammal, Mr. Forbes, as I have mentioned, has

promised to follow me with a particular description. Merely remarking, therefore, that the quantity of fragmentary bones of fishes and of the moa shows that these were the animals principally eaten by the natives inhabiting the cave, I proceed at once to specify what things other than bones have already been brought to light. Enough have been found to make the nucleus of a small museum. Such articles as a fisherman needs for the pursuit of his craft are the most common. Two objects first attract attention, because of their size and more finished workmanship. These are a well-made paddle or steer-oar of kauri (?), 7½ft. long and 6¾in. across the blade, and a nicely-carved unique-handled scoop of totara (?), 15in. by 8in., for baling the water out of a canoe. These are the articles referred to above as having been found immediately when the cave was opened, in a sort of natural cupboard or cleft in the rocky side of the outer chamber. Then there is a large piece of wood, that may have been part of a canoe or perhaps a sort of frame or pole for supporting a fishing-net. It is 6ft. long and has three groups of holes in it, each group containing four holes. There are also over thirty fish-spears of bone, of several sizes, from 5in. to 1in. in length, and of different patterns, some notched on both sides, some only on one; a number of stone sinkers up to 3½in. in diameter, and generally of sandstone; floats of pumice-stone; fish-lines of plaited flax; and pieces of net. A large number of stone implements have been found—over a dozen adzes, some highly finished, some very rude, one (a fragment) so broad and massive in the polished portion as to remind one of the domestic flat-iron, and to suggest the probability that it was used for smoothing or polishing rough surfaces; others with very fine sharp points, as though intended to be used as awls for boring holes in wood, bone, or stone. There are, besides, a number of greenstone chisels, one gouge-shaped; and the large quantity of pieces of obsidian, fragments of basalt, and flakes and blocks of chert or flint shows that such rude stone tools as the denizens of the cave required they were in the habit of fashioning on the spot. We found also a fern-root pounder of wood, 14in. long; a beautifully delicate needle of ordinary size, 1¼in. long, of bone, with the eye perfect; fire-lighters 9in. long; and a comb 5in. long, 2½in. across. The latter article is at the present time very brittle and somewhat decayed, like the other wooden implements in the cave. It was found in fragments, but must at one time have been of considerable strength, or it certainly would not have been serviceable for the purposes for which it was intended. Great handfuls of human hair were also found, one coil plaited, two or three wrapped in flax, mostly very dark in colour, but some light as the auburn hair of Europeans and carefully tied; and feathers of various birds,

mostly aquatic, fragments of skin of different kinds of Phocidæ, with the hair still attached, and a large quantity of shells of apparently the same species as are now found on the beaches in this neighbourhood. Besides these there are many fragments of wooden implements, all very brittle with age, the precise nature and purpose of which it will be difficult to decide. But all are evidently of Maori manufacture—nothing whatever of European origin has been found; clearly showing that the cave gives us, so far as it goes, a faithful photograph of the original Maori life. Some of the articles have apparently been intended for ornament, as certain little articles shaped like the *chelæ* of a crab or lobster, and others of the shape and size of a penny-piece with a hole through the centre, and a beautiful greenstone pendant, with a hole bored through it. How this was perforated it is difficult to conceive, for even now lapidaries can only bore greenstone with diamonds, as the metals will not mark it.

One article would almost lead to the belief that the Maoris made toys for their *tamariki*, or pickaninnies. It is a fairly-well-carved image of a dog, about 4in. long. Its tail is so curled up as to form a ring, by which it could have been suspended either as an ornament or charm. It may, however, have been only the handle of some implement or weapon, for there are few articles in this collection bespeaking a frivolous existence. Most of the things were such as would be demanded by hard necessity, and bespeak a life that "scorned delights and lived laborious days," though not in the poet's sense exactly. Of such would be the firesticks (*kauwahi*), apparatus for lighting fire by rubbing one piece of stick in the groove of another (of which there are several specimens), the fern-root beater (*patuaruhe*) aforementioned, pieces of spear, fragments of the parts of a boat, and so forth. Many of the fragments are more or less charred, and there is other evidence that in different parts of the first chamber of the cave, and at different times, cooking was usually done, and fires often kept burning.

It only remains for me to say that the entrance to the outer chamber is easy enough, scarcely involving stooping. Inside, above the *débris*, the roof is arched, and at least 10ft. in the clear. To explore the middle chamber it is almost needful to glide snakewise; but once in, and in the centre, and you have a space above the floor 15ft. in the clear. As for the third chamber, that practically is unexplored. The approach to it is 10ft. long, and very narrow and circumscribed, and an arch of rock is before the entrance. It is almost filled with *débris;* yet it was evidently once much frequented, for the lava stone which forms the doorway is worn perfectly smooth at all exposed points, as if by human

being or other animal daily or hourly passing to and fro and rubbing against the sides. It is more than likely that this was for centuries, perhaps, the abode of sea-lions, the seclusion of such a retreat being just what those animals would seek, and we know that they were plentiful enough about here when the Maoris inhabited the cave, because of the number of fragments of sea-lion fur found in the *débris*. At present the outer chamber promises most reward for digging and clearing away. The second chamber is less inviting to the explorer, but may prove more productive of bones and other relics than is now thought.

Appended is a plan of the cave (Pl. I.) and sketches (Pl. II.) of the principal Maori implements and other articles therein found.

DESCRIPTION OF PLATES I. AND II.

Plate I.—Monck's Cave near Sumner, Ground Plan.

Plate II.—Articles found in the Cave.

Fig. 1. Wooden model of dog (?), $\frac{1}{2}$.
Fig. 2. Carved head of stick or paddle, $\frac{1}{5}$.
Fig. 3. Paddle or steer-oar, $\frac{1}{12}$.
Fig. 4. Comb, $\frac{1}{4}$.
Fig. 5. Bailer, $\frac{1}{7}$.
Fig. 6. Fish-hook, $\frac{1}{5}$.
Fig. 7. Fire-lighter, $\frac{1}{6}$.
Fig. 8. Hook (perhaps for suspending an ornament), $\frac{1}{4}$.
Fig. 9. Fern-root pounder, $\frac{1}{7}$.
Fig. 10. Greenstone pendant, $\frac{1}{6}$.
Fig. 11. Needle (bone), $\frac{1}{3}$.
Fig. 12. Adzes, $\frac{1}{3}$.
Fig. 13. Fish-spears, $\frac{1}{5}$.

Art. VI.—*On the Disappearance of the Moa.*

By Major W. G. Mair.

[*Read before the Auckland Institute, 11th November, 1889.*]

So much has been said and written about the question of whether the Maori people were familiar with the moa, or whether the great bird was practically extinct when the Maoris reached the shores of New Zealand from Hawaiki, about twenty generations ago, that it may be thought that there is nothing left unsaid about it; but I do not think that the matter has been set finally to rest, and perhaps it never will be. Still, every possible scrap of information bearing upon such an interesting point should be placed upon record before the time comes when we cannot possibly collect anything more. For this reason I contribute what little information I

have been able to gather directly from the Maoris themselves. I will say at once that I am a supporter of the belief that the Maoris *never had any personal knowledge* of the moa. I have often thought of writing something about this question, and should probably have gone on thinking about it for an indefinite time but for reading in last year's proceedings of the Wellington Philosophical Society the discussion which took place over Colonel McDonnell's paper on "The Ancient Moa-hunters at Waingongoro."* The most marked thing about that discussion was the way in which the advocates of what may be called the prehistoric-extinction theory were "sat upon" by the other side, not with weight of argument, but mere force of assertion. I believe that the chief argument in favour of what I will call the recent-disappearance theory is the fact that on the plains and hills of the South Island moa-bones were found in large quantities by the first settlers on the surface of the soil, and that the rapidity with which they decayed and disappeared was sufficient proof that the bones could not have been long in that position. But this argument was not used in the discussion to which I have referred; and, further, I am only dealing with the North Island and with the Maori evidence, for Colonel McDonnell's paper was based upon an account of moa-hunting related by the late Kawana Paipai, a well-known Wanganui chief. I remember hearing the late Judge Gillies say that Mr. John White had collected songs describing the hunting and cooking of the moa, and that Apanui Hamaiwaho, a Whakatane chief, had told him all about the killing of the "last moa" by a famous hunter called Hape, near Mount Edgecumbe. I do not know what other stories of the kind may have been put on record, but it appears that on such evidence we are expected to believe that down to recent times the Maori hunted the moa. At the Wellington society's meeting to which I have referred, it was explained that it was owing to the moa being such a common object, and the killing of it such an everyday occurrence, that so little reference was made to it in songs or legends; but surely this is no argument, for rats, pigeons, &c., were common enough, yet we have songs and *karakias* about them, and long accounts—some of them of great antiquity—describing their hunting or capture. If the moa was ever hunted by man, it is reasonable to suppose that the principal method of taking it would be by means of pits, after the manner in which the ostrich was captured, but not by running it down as described by Kawana Paipai. The Maoris are not runners—in fact, none of the Polynesians are. But has any one heard of a pit or trap for catching moas? During the present year I have seen in the King-country *paepae kiore*

* "Trans. N.Z. Inst.," vol. xxi., p. 438.

(rat-pits) in excellent preservation. No man living had seen rats caught in these pits, but their history was known, and it was evident that they were traps for some small animal.

And now with reference to what I have been able to learn about the Maoris' knowledge of the moa. Everybody, no doubt, has heard the story of the "last of the moas" living in a cave on the side of Whakapunake Mountain, near Wairoa, Hawke's Bay. At nightfall it used to descend to the plains and roam about. When it wished to return it rushed with great speed along the level ground, and the impetus thus gained carried it up the precipitous mountain-side to its den, where it was guarded by a *taniwha* (dragon), whose awful loud breathing was sufficient to deter any one from approaching. This story was told me first by Hori Ngawhare, a Manawatu chief, who died at Waotu in 1871, but I have heard it often since then in different places. Hori also told me that before Rauparaha's migration to the south in 1819 he was living at Maungatautari, and remembered the finding of some *iwi moa* (moa-bones), which were afterwards fashioned into ornaments, and were highly prized. I knew the late East Coast chief Apanui very well, and among other things he told me the story of Hape and the moa; but it does not agree with what Judge Gillies said was told to Mr. White. A few miles to the westward of Mount Edgecumbe there is a high steep hill on the right bank of the Tarawera River called Te Takanga a Hape. Apanui's tale to me was that Hape pursued a moa to the summit of this hill, when, thinking it exhausted, he reached forth his hand to seize it by the leg, but it lashed out and hurled him back into the valley by the river-side. Being a *tangata atua* (god-man) he was not killed, but the spot was called Te Takanga a Hape (where Hape fell). Hape's name is connected with various places in that locality. Further up the valley the Tarawera River, flowing from the lake of that name, runs for two or three miles between low rocky banks until it approaches the verge of an enormous precipice, when suddenly it disappears, and then, bursting again from the face of the cliff, it forms a beautiful cascade in a wooded glen far below. It is evident that at one time the river flowed over the full height of the precipice, but it is said that Hape, after the whimsical fashion of divinities, struck the rock with his heel and caused the water to flow in its present subterranean channel; so the place is called Te Tatau a Hape (Hape's doorway). It is over twenty years since I visited this spot, but I remember thinking it one of the most remarkable and beautiful objects that I had seen. I merely mention this place to show that Hape, who is said to have killed the "last moa," belongs to the "dim past;" and so, I believe, do all the genuine stories about the moa. That the

moa did exist in that region there can be no doubt, for part of a femur was found in 1869 on the bank of the Rangitaiki River, in the face of a cliff of pumice-gravel, and in the year following some broken bones were revealed by a landslip at Maungapowhatu. An Uriwera chief wrote to me about the find, and even forwarded a sketch of the specimens, for which the discoverer expected to receive a large price; but, as he could not find a purchaser, the bones were worked up into *poriokaka* (rings for the legs of pet parrots) and *aurei* (pins for fastening the mat over the shoulder). I may mention that the *aurei* were often worn in bunches hanging in front of the right shoulder: they were made from sperm whale's teeth, and in recent times from boar-tusks. I have in my possession a very beautiful *aurei*, which is perhaps unique. It was given to me by an Uriwera chief upon his coming out to the coast to make peace in 1866. He said that it had been "in the possession of his family for twelve generations, and that it was an *iwi moa.*" An old Whakatohea woman told me that her grandmother had seen moa-plumes adorning the head of a great chief, and that they were "coloured like the rainbow." When I asked the Uriwera what the moa was like they said it was a *tipua* (a mythical creature) that could change its form at will to a tree, or stone, or any other object, but its favourite transformation was to a *kaponga* (fern-tree).

When I became acquainted with the Ngatimaniapoto people, in 1871, I asked some of them to tell me what they knew of the moa; and the answer was, "We do not know anything about it, but perhaps our ancestors did." I said, "Why, you helped Von Hochstetter to dig up bones at Pukemapau and other places." And they replied readily, "Oh, yes! we knew of the bones, but we did not know what the creature was like until the doctor told us it was a great bird taller than a man or a horse."* This is all that I have been able to gather from the Maoris about the moa, and I will state now what I have *not* been able to gather.

For many years I have been, I may say, recording Maori history: I mean the history of their land-claims as given in our Native Land Courts. In the interior of this island there are great tracts of forest, plain, and mountain country, which

* Since writing the above I have heard another story about the extinction of the moa. Mr. L. Fraser, the caretaker of the Waitomo Caves, informs me that Tutawa, an old Ngatimaniapoto chief, who lives at the caves, told him that when Ngatoroairangi, who came in the Arawa canoe, received the sacred fire brought by his sisters from Hawaiki, he applied it to the bush about Taupo, and the country became covered by flames and smoke, and the moas, seeking refuge in the caves, perished in great numbers.

show no trace of permanent occupation, but were the tribal preserves or hunting-grounds. Disputes often arose about the rights to these places, resulting in raids or wars, ending sometimes in the subjugation or even complete destruction of a tribe or *hapu*. The histories of these events are related at great length, as also the various processes for catching birds, rats, and fish, with the *karakias* (incantations, or charms) used, even hundreds of years ago. We are told, for instance, how Hiaora, who landed from the canoe Tainui twenty generations ago, travelled up the valley of the Waipa to spy out the land. Arrived at Maungarangi, near Otorohanga, he set up his *tuahu* (altar) brought from Hawaiki and called Moekakara, and there spread his snares in the mangeao trees to catch pigeon, tui, and kaka. Meanwhile his rival, Rotuhuakioterangi, had established his *tuahu*, called Tanekaitu, in full view, at a place called Paewhenua, and had spread his snares, and then it was a question of which of these great *tohunga* (priests or seers) could work the most powerful enchantments; and at last Hiaora prevailed, and the birds flew in clouds into his snares. There was one great bird, called Tauherepu, which broke the snares; but as it sat in a tree Rotu thrust at it with a long spear, and it flew away to Mokau, where in after years it was killed by the descendants of Hiaora, who had been expelled from the place where their ancestor first set up his *tuahu*. This great bird is supposed to have been the last of its kind. We are told, too, how large lizards (*ngarara*), now extinct on the mainland, were kept by the Maoris as *mokai* (pets or favourites). Even their names are handed down, and those, also, of birds and dogs. Then they point out to us the individual trees where their ancestors set their snares for the various kinds of flying birds, the paths on the mountain-ridges where they hunted the kakapo or the kiwi, the pitfalls made for the fruit-eating rat, and the sites in the streams of the weirs for eels, lampreys, and smaller fish; and in all these thousands of pages of Maori lore which I have written from the mouths of witnesses in Waikato, at Rotorua, in the Bay of Plenty, Hawke's Bay, Manawatu, Wanganui, and Taupo, there is not one word about the moa. I repeat that the argument to which I have alluded, that the bird was so common that the Maoris did not take sufficient interest in it to describe how it was caught, or to fight over the possession of it, or to tame it as a *mokai*, or to make a proverb, song, or *karakia* about it, is valueless, for we know that they did all these things about rats, tuis, and other small fry which existed in far greater numbers than the splendid moa. If scientists who have made a study of the subject say that the position in which remains have been discovered, and the rapidity with which bones lying exposed to the elements have decayed, is sufficient evi-

dence of the bird's existence in the South Island, at least, in recent times, that is an argument entitled to our consideration; but if we are to be told that the evidence of the Maoris themselves places the matter beyond dispute, then I say that it is due to those who hold the opposite view that the evidence should be put on record.

ART. VII.—*The Moriori.*

By EDWARD TREGEAR, F.R.G.S.

[Read before the Wellington Philosophical Society, 4th December, 1889.]

THE Chatham Islands are a small group about four hundred miles to the eastward of New Zealand. They were originally inhabited by a race called Moriori, a people akin to the Polynesian Maori not only in appearance, but in language. The Moriori are on the average slightly shorter and broader than the Maori, but the hooked nose sometimes seen on the Maori face, especially in the north, is here very common, and in some cases exaggerated to portentous dimensions. They differ in some customs from the Maori: thus, they do not tattoo, and know nothing of the art; they appear to have had a regular marriage ceremony; and the disposal of the dead was peculiar: If a man celebrated as a fisherman died, he was lashed in a sitting-posture to a canoe and sent out to sea; if a great bird-catcher, his body was fastened to a tree with the face turned towards the locality he had most hunted over in life. The women were married very young in order to prevent any indiscretion: adultery was punished by the offender being beaten nearly to death with clubs. The women ate apart from the men, in the usual Polynesian fashion. The ancient huts were either Λ-shaped, like those of the Maori, or conical, and formed by bundles of poles tied together at the top, after the fashion of the North American wigwam. Children were baptised (*i.e.*, named, with sprinklings, &c.) with ceremonies accompanied by the planting of a tree, as in New Zealand. The New Zealand birds to be found in the Chathams are the tui, hawk, pigeon, pukeko, fantail, lark, and titmouse; but formerly they had a kiwi, the bittern, weka, white crane, and kakapo.

In 1832 the Maoris of the Ngatiawa and Ngatimutunga Tribes made a raid upon the Chathams. They found a peaceful and inoffensive people utterly unable to resist them, and they took possession, treating the Moriori like sheep for the butcher, which simile they carried further by devouring them wholesale.

Several accounts have been given by Maori scholars as to the landing of the Moriori in the Chatham Islands. One tradition states that when they arrived they found the country in the possession of aboriginal natives called Hiti, whom they dispossessed. Captain Mair ("Trans.," vol. iii.) writes that they came in five canoes—viz., Rangitane, Rangihoua, Rangimata, Ruapuke, and Okahu; that they had set out from the villages of Tahurimanuka and Wharepapa, in Hawaii; that the immigrants were of the tribes of Rongomaitere and Rongomaiwhenua; and that Kahu was captain of the Okahu. Mr. Travers ("Trans.," vol. ix.) states that the first strangers came in the Rangimata, under Mararoa, and the Rangihoana, under Kawanga-Koneke. The second arrival was the Oropuke canoe, under Mohi, from Awatea or Arapawa (names of New Zealand). Mr. John White (App. to Jour. H. of R., G.–8, 1880) says that in comparatively modern times the ancestors of the Moriori came from New Zealand in two canoes, the Kimi, under Rangihou, and the Rangimata, under Mihiti, the other canoes being lost at sea. A second migration arrived afterwards, under Moe, in the canoe Rupuke. Moe was the first to introduce cannibalism.

I was desirous of ascertaining what was the most valuable source of tradition in regard to this matter, and also of finding out, if possible, the lapse of time which ensued between the different migrations, by acquiring a genealogy of the Moriori. I especially wished to commune with Hirioana Tapu, the last chief of the tribe, and the only reliable source of information now accessible, as he is getting old, and no one conversant with the old songs, legends, &c., will be in existence when he has left us. He gave me much information in the short time at my disposal, but was unable to recite the perfect genealogy of his forefathers. Fortunately, Mr. A. Shand, of Waitangi, who is an ardent student of Moriori, had acquired the wished-for genealogy from Minarapa Tamahiwaka, an old priest, now dead. This Mr. Shand kindly put at my service. I am unable to give the genealogy at full length, as I wish it to form part of the collection of Mr. Shand (who will shortly publish it), but the general information is as follows: It comprises 184 generations, which, if we accept it as authentic, is a most extraordinary and valuable record, reaching nearly 3,700 years, if we allow twenty years to a generation. It commences with Rangi and Papa (Heaven and Earth) as the first parents, and proceeds, through names well known in Polynesian legend, down to Tauira, the thirtieth generation. These thirty generations are called Te Whanau o te Rangi (Children of the Heavens). Thence the pedigree proceeds to the 157th, when Rongopapa was living. At this time came the canoes from Hawaiki—viz., the Rangimata, under Mihiti, the Rangihoua

(which seems to have had no great chief, but the two most important persons were Tunanga and Tarere), and the Oropuke, under Moe. No interval of time of any great extent appears to have lapsed between the arrival of the Oropuke and of the other canoes. There is a distinct tradition to the effect that Kohu, in the canoe Tane, first discovered the Chatham Islands, but that he returned to Hawaiki. The largest island of the Chathams is called Rekohu (Rangi-kohu) after the name of this explorer. The old Moriori chief Tapu seemed positive that the Moriori were the original inhabitants and true "children of the soil," and that the three canoes were the first arrivals from Hawaiki. It is evident, however, from their vocabulary (which is a corrupt provincial dialect or *patois* of New Zealand Maori), from their songs, and from the genealogy, that they are a true branch of the Polynesians, and have come from the same far-off Hawaiki, if any reliance is to be placed upon tradition, and if the Polynesians are not autochthonous.

From Tapu I obtained the old names of the months as follows:—

January	...	*Te Tuhe a Wairehu* or *Ko Tuhe a Wairehu*
February	...	*Ko Moro*
March	...	*Mihi to Rekau*
April	...	*Te Upoko o Tchtcheao*
May	...	*Tuma Tchihae*
June	...	*Kahu*
July	...	*Ko Rongo*
August	..	*Tae he*
September	...	*Ko Kaitanga*
October	...	*To Inapota*
November	...	*Wairehu*
December	...	*Tuhe a Takarore.*

These names differ from those used by the Maori, and are all names of persons. The "tch" written above is peculiar to Moriori, and is only met elsewhere in Tonga and the other Friendly Islands. The Maori word *tamaiti* (child) becomes *tchimitchi*, or even *tchimitch*, the Moriori being fond of clipping the last vowel off a word. The name of the people originally owners of the Chathams is given as Tch amata.

The nights of the moon are as follows: 1, Omutu; 2, Owhiro; 3, Otere; 4, Ohewata; 5, Oua; 6, Okoro; 7, Tamate tutahi; 8, Tamate turua; 9, Tamate nui; 10, Tamate hokopà; 11, Ohua; 12, Owaru; 13, Hua; 14, Mawharu; 15, Outua; 16, Ohotu; 17, Maure; 18, Oturu; 19, Rakaunui; 20, Rakau motòhe; 21, Takirau; 22, Oika; 23, Korekore tutahi; 24, Korekore turua; 25, Korekore hokopau; 26, Tangarò a mua; 27, Tangarò a roto; 28, Tangarò kikio; 29, Otane; 30, Orongonui; 31, Orongo mori.

I was pleased to find that the Moriori had legends as to the existence of an enormous bird, which they state once existed on the largest island. Its name was *poua*, a word which one has little difficulty in recognising as being akin to Pouakai, the gigantic man-eating bird of the myths told in the South Island, New Zealand. This does not seem, however, to have been a huge flying bird, but to have resembled some great Apteryx, since the last survivors of them were driven by the natives into Te Whanga lagoon, and there drowned. No bones, however, are procurable, and the *poua's* skeleton is unlikely to attract interest in our museum for some time.

Some little time ago I saw in the Australian papers a discussion as to the date on which the last aboriginal native of Tasmania died, a question having arisen whether a certain woman recently dead had been a full-blooded native or only a half-caste. Information respecting a kind of native census, which had been made long before, was produced in the effort to settle the question. Thinking that, as the Moriori are rapidly dying out, scientists at the end of the next half-century might be interested in knowing what was the exact state of the native population in 1889, I made a census-inquiry, with the following result:—

Chatham Islands, 23rd September, 1889.

At Manukau.

Men: Hiriona Tapu, Tiritiu Hokokaranga, Heta Namu (half-caste, Maori and Moriori), Horomona te Rangitapua, Apieta Tume, Te Karaka Kahukura, Te Ohepa nga Mapu (half-caste, Maori and Moriori).

Women: Rohana Tapu, Paranihi Heta, Pakura te Retiu, Himaira Horomana, Harireta te Hohepa, Ruiha te Hira (half-caste, Maori and Moriori).

Children: Tame Horomana (boy), Mika Heta (boy), Ngana Riwai (girl).

At Kaingaroa.

Men: Hoani Whaiti Ruea, Te Ropiha Rangikeno (an old man), Riwai te Ropiha, Tamihana Heta.

Women: Eripeta Hoani Whaiti, Kiti Riwai (a quarter-caste pakeha—*i.e.*, child of pakeha and half-caste woman), Emiri Parata (half Maori, half Moriori).

At Waitangi.

Men: Pumipi te Rangaranga (a very old man), Heremaia Tau, Wi Hoeta Taitua, Te Teira Pewha, Timoti Wetini, Taitua Hangi, Temuera Numi.

Women: Hipera te Teira, Paranihi Taitua, Ereni Timoti (or E Puti) (half-caste, Maori and Moriori).

Making twenty-seven of pure Moriori descent, and five half-breeds. The Maoris on the islands number about two hundred and fifty souls, and there is roughly about the same number of a white population.

The island (Rekohu) is an exceedingly pleasant place of residence. The sea surrounding it equalises the temperature very much, and prevents extremes of heat and cold. The island in many places is extremely fertile, and I never saw more beautiful soil than the land at Owhenga, on the eastern side, near the large Moriori Reserve.

It would be desirable, if possible, for the society to acquire the large collection of axes, clubs, &c., of stone now in the possession of Mr. Clough. They could be obtained, I believe, for a very moderate price, and it would be a pity for such a collection (which could never be replaced) to find its way into the possession of private persons and tourists. Among other curiosities is a bone dagger, about 9in. long, the blade being about 4½in. in length, with a double edge. I do not know of any other Polynesian people having used the dagger except the Hawaiians (of course I do not refer to the common bamboo knife of the South Seas), but Tapu assured me that the weapon was known and used by the ancient Moriori.

ART. VIII.—*Notes on the Great Barrier Island.*

By SIDNEY WEETMAN, F.R.G.S.

[*Read before the Auckland Institute, 22nd July, 1889.*]

EARLY in July, 1885, I was sent to the Great Barrier Island to execute some surveys for the Government; and, although it was supposed at the time that the work would occupy only about two or three months, yet, owing to the rough nature of the island and to additional surveys being required, we remained there within a few days of a year, leaving it on the 11th June, 1886, the day after the memorable Tarawera eruption, which we distinctly heard, but, of course, did not know what it was.

Although the Barrier lies only about fifty-two miles from Auckland in a north-east direction, very little seems to be known even by old Aucklanders as to its extent, formation, and capabilities—so little, indeed, that I have heard more than one person speak of it as only a rock, and wonder what we could possibly find to do there for a whole year; and I have been asked whether in that time we surveyed the whole island, to which I was compelled to confess that we had surveyed—or, rather, resurveyed—only a very small portion of it.

As I believe that in some future time it will become the Isle of Wight of New Zealand, owing to the salubrity of its climate, its very picturesque and excellent harbours, and its hot springs, perhaps a short description of it may prove interesting.

Its length is about twenty-two miles in a north-and-south direction, its greatest width about twelve miles, and its least about two miles and a half, comprising in all an area of about 74,000 acres, 30,732 of which were acquired by the Barrier Company, 3,514 are still in the hands of the natives as reserves, and of the balance of 39,754 acres about half is freehold and half Crown land.

The whole of the island is broken and rocky, the central portion particularly so. The highest hill is Hirakimata, or Mount Hobson, situate about the centre of the island, at an elevation of 2,038ft. above the sea. A few hundred feet lower down, and clustering round Mount Hobson, there are several bold and picturesque peaks, some of which are composed of uplifted palæozoic slates, in some instances standing completely on end, and, covered as they are from their bases nearly to their summits with dense forest, containing a large proportion of excellent kauri, they form very striking objects to the artistic eye.

For a distance of about three miles north and south of Mount Hobson the palæozoic pink slates extend, forming a zone six miles in breadth almost across the island in its widest part, and broken up into many peaks and precipices. At the eastern margin of this zone there is a fringe of breccia, yellow sandstone, and blue slate; and its western shore is fringed almost entirely by "puddingstone," or breccia, forming between Whangaparapara Harbour and Port Fitzroy bold overhanging cliffs.

The southern part of the island—that is, from Whangaparapara southwards—is chiefly volcanic formation, and, although very broken, is much less so than the central portion. It was cut up by the Government some twenty years ago into farm-sections ranging from 50 to 200 acres in area. Several of these were taken up, but at present there are only some twenty settlers with their families living on them. The soil is good, and takes grass very readily.

North of Blind Bay, and about two miles distant in a northerly direction, there is an extinct crater named Ahumata—probably from the large quantities of obsidian to be found on it—the highest portion of which is 1,292ft. above the sea. The eastern side forms a perpendicular cliff for some distance, called the White Cliffs, which, when lit up by the morning sun, appears of a dazzling white, the rock being, I believe, a trachytic felstone. Professor Hutton, in his geological report

on the island, says, I think, that this crater must originally have been nearly a mile in diameter, although it is hard to realise this at present, as it is very much worn down on its southern and western sides. Large masses of the rock, several tons in weight, and in some cases a pure white, have become detached and have rolled down on to the spurs below, and at a distance present a very peculiar appearance, some of the larger ones looking like tents spotted about, and others like mobs of white cattle.

About a mile and a half from the summit of Ahumata, and in a direct line with Rakitu, or Arid Island, there is a hot spring, which appears in a small stream running into the Kaitoke Creek; and about the same distance further on, and in the same line, more hot springs are found, on the main branch of the Kaitoke. As before mentioned, these springs are in a direct line between Ahumata volcanic hill and Rakitu Island, which lies about one mile and three-quarters in a north-easterly direction from the Barrier, and which is also an extinct volcano. Why named Arid Island is not known, since what soil there is on it is very fertile. The only piece of flat land on the Barrier of any extent is situate on the east coast and about midway, at a place named Owena. The flat is about 200 acres in extent, and is bounded on the north by the Owena River. One settler and his family live there. From there to Harautanga Bay, where one or two settlers live, is about three miles in a northerly direction; and about three miles and a half in a straight line, but nearly double that distance by the track, the Whangapoua River joins the sea. Here two more settlers live. I believe there is another north of this, at a place called Tapuwai, but I did not go there. Then, on the western side, in Fitzroy Harbour and Port Abercrombie, there are ten more families scattered about the shore, making in all on the island about thirty-six *bonâ fide* settlers, all of whom, owing to the rough nature of the island, live close to the sea. The whole population by the last census amounted to about two hundred and twenty.

Of the portion of the island lying north of a line running from Karaka Bay, in Port Abercrombie, to Whangapoua, I regret to say I know nothing personally, my duties not having taken me there; but I believe the formation, like that south of Whangaparapara Harbour, to be of volcanic origin, overlying the palæozoic slates which form the central zone before mentioned.

On the western corner of the northern end of the island a copper-mine was worked many years ago by an English company, but was abandoned, like many others, before it had made anybody's fortune. There is, I believe, some talk of the mine being reworked.

Besides the *bonâ fide* settlers there are on an average about forty or fifty gum-diggers, who find the gum in the central portion of the island where the ground is not too rocky for their operations. A curious feature of gum-digging at the Barrier is that they get what is termed "old gum" in the forest as well as in the "open;" and a still more curious feature is that it is found on the crater of Ahumata, on which, to judge from its arid appearance, one would conclude that no trees, save a few stray pohutukawas, had grown since the eruption. And, moreover, the gum is said to be obtained from different layers of clay. Mr. John Blair, jun., to whom I am indebted for the statistics as to population, industries, &c., says that "they are now getting gum in the third layer of clay—that is, they dig through the surface and get gum in the clay; then they go through that clay, and get it on the next layer, a different crust-formation; and some are going through that clay to the rock, and still getting gum; showing gum in three different formations: but the lowest gum is so old and 'rusty' that half of it has to be scraped away before it is marketable."

A great deal of kauri timber has been taken from the island, and a large quantity still remains; but, as it is confined almost exclusively to the slate formation, which is the most broken and precipitous part of the island, it is very difficult of access. When I was there a "bush" was being worked on the eastern side of the island, and the timber shipped in scows at Harautanga Bay to Auckland. During the last thirty years hundreds of thousands of tons of excellent firewood have been taken from the island, but at present it is believed that not more than 150 or 200 tons a week are exported.

Some of the settlers go in extensively for bee-keeping, and one, I believe, last year extracted 12,000lb. of honey from his hives, and another 8,000lb.

Of minerals, gold, silver, and antimony are said to have been found on the east coast, near Harautanga; but, as far as I know, payable fields have not yet been discovered. Professor Hutton, in his geological report, says something like these words: "From the general absence of iron-pyrites I am compelled to think that gold will not be found." Let us hope that he may prove to be a false prophet.

To the artist, geologist, and botanist the Great Barrier presents many objects of interest. A climb to the top of Mount Hobson on a clear day well repays the necessary exertion, as the whole island appears to lie at your feet, and there is very little of it which is invisible. Rangitoto and Auckland are easily seen, as well as a long trend of coast-line northwards; also a splendid view is obtained of Cape Colville and the Mercury and Cuvier Islands southwards.

From the broken nature of the island agriculture on a large scale is out of the question; but cattle- and sheep-farming and fruit-growing should flourish. Oranges, and perhaps bananas, might be grown in large quantities, while the climate is all that can be desired—extremely healthy, and milder than that of the mainland.

Unfortunately, there are not any harbours on the eastern side; but those on the western—Katherine Bay, Ports Abercrombie and Fitzroy, Whangaparapara, Blind Bay, and Tryphena — all afford excellent anchorage and shelter for shipping.

There are evidences in several places that the island must have at one time been inhabited by large numbers of the Maori race, for, apart from the remains of several pas—some of which in the rockiest places are built up of loose rocks, instead of being entrenched by digging as usual—there are places in the forest, notably at Korotiti, on the east coast, which mark the site of their old habitations and cultivations, the slopes of the hills being terraced, and the ground supported by stone facing; while in other places enclosures are fenced in by stone walls, which are as straight and well built as those constructed by Europeans. Out of these enclosures large trees are growing, more than a foot in diameter. In and about these enclosures I looked in vain several times for some relic of Maori workmanship. This is the first instance, as far as I am aware, of the Maori race—if they were Maoris—having terraced the hillsides and built stone walls. There are also, in places now likewise covered by forest, large heaps of stones, which had evidently been collected from the surface prior to cultivating the land.

Almost in a direct line between Mount Hobson and the principal hot springs there are several very remarkable-looking peaks, known as the Pinnacles, which tower up above the kauri forest, and form a bit of scenery which in its way is quite unique. The lowest of these Pinnacles I christened General Gordon, because looked at from some positions it resembles the figure of a colossal man, standing with his arms behind him, looking out over the sea, and, as my visit took place shortly after the fall of Khartoum, this rock suggested to my mind the lonely figure of Gordon, as one might imagine him looking out from the palace-roof for the relief-expedition which never came. There is another peculiar dome-shaped rock named Maungapiko, close to the track leading from Whangaparapara to the Waiarihi Creek, which I take to be an outcrop of serpentine, although Professor Hutton does not, I think, mention it in his report.

I had heard before going to the island that the late Mr. Theophilus Heale, who at different times had lived there, and

had travelled over every portion of it, was of opinion that in the neighbourhood of the Black Rocks, situate at the head of the Kaitoke Stream, there are remains of terraces similar in formation to the far-famed Pink and White of Rotomahana, only on a far grander scale. Having had little or no time for exploration where my duties did not take me, I was unable to determine their site; moreover, not being an expert in the matter, I might not have been able to recognise them.

Not being anything of a botanist, I cannot describe the forest technically, but I think most of the trees found on the mainland grow on the island, and there are one or two peculiar to it—namely, the Barrier pine, which, when young, resembles very closely in appearance the macrocarpa, but when it grows up it loses this resemblance.

Of birds, the tui and pigeon are the most numerous, and it is a curious fact, which perhaps has been noticed elsewhere, that the note of the former differs to a certain extent in different parts of the island. The sound of many tuis acting in concert in the dense forest on a bright morning has a very charming effect. We saw and heard a pair of bell-birds at the head of Whangaparapara Harbour, but they seemed to be very scarce. The pukeko also is heard, but very seldom seen, in the swamp at the northern base of Ahumata. This bird, which is apparently very weak on the wing, and flies with its legs dangling, is the most ubiquitous of all birds, as it is, I believe, found throughout Australasia; and its means of transit are as much a puzzle as that of the wingless waterfowl which inhabit most of our small lakes.

My party found some bones on the beach at Owena which turned out to be those of a small species of moa, but how they came there it is impossible to say. This is interesting, as having been the first instance known of moa-remains being found off the mainland.

To conclude, with all the advantages of climate, scenery, hot springs, and picturesque harbours, I cannot but think that in the future this island must become a sanatorium for overworked Aucklanders. At present there are not any roads, and the tracks are of the very roughest description; but all this will be remedied with an increasing population.

Art. IX.—*Tongarewa, or Penrhyn Island, and its People.*

By S. Percy Smith, F.R.G.S.

[*Read before the Auckland Institute, 14th October, 1889.*]

When I had the honour of reading to the Auckland Institute my presidential address, on the 4th June, 1888, I ventured to call attention to one subject amongst others which our founders had laid down as part of our duty to follow up—viz., "the collection of material for the history and better understanding of the Maori race and the allied races of the South Pacific." Acting on this precept, I have essayed in the following pages to place before you some notes on one of the Polynesian islands and its inhabitants, gathered from various sources, but principally from a work* by Mr. E. H. Lamont, of San Francisco, who, together with his comrades, was wrecked there, and lived amongst the people as one of themselves for over eight months.

Being one of the first Europeans who ever resided on the island, Mr. Lamont had opportunities of observing the people in their original savage state, which was typical of many of the coral islands of those seas before the advent of the pearl-fisher, the slaver, or the seeker after *bêche de mer*. His narrative, therefore, is a valuable contribution to the study of the race.

My part in these notes has simply been to show the relation the customs and language of the people have to those of the Maori. I have not hesitated, therefore, to alter Mr. Lamont's orthography of names of places, people, and words to make them agree with the method of spelling adopted in all Polynesian languages, and to thereby render them capable of comparison. In so doing some errors may have crept in, but I believe them to be few.

The island has an interest to us just now, inasmuch as it is one of those lately annexed to the British Empire—a duty which was performed by H.M.S. "Egeria" in the early part of this year. It has this further interest also: that the people are very nearly allied to our Maoris in their customs and language—much more so, indeed, than the inhabitants of many islands nearer to New Zealand in point of distance. That the people are one and the same race no one who studies the names of places and list of words appended can have any reasonable doubt. And this fact is further borne out by the traditionary account of their origin given below, in which it is stated that they came from Rarotonga, from whence also came some por-

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* "Wild Life amongst the Pacific Islanders." E. H. Lamont. London, 1867. Hurst and Blackett.

tions at least of the Maoris on finally leaving their Pacific home. It is not intended to enter into this question here, further than to state that the more it is studied in all its bearings, the more certain is the conclusion that Rarotonga, and perhaps the neighbouring islands, were the homes of some of our Maoris, from whence they came here to New Zealand, though they were well acquainted with most of the islands forming the Fiji, Tonga, Samoa, and Tahitian groups as well.

Penrhyn Island, or group, situated in 9° of south latitude and 157° 10′ west longitude, is a true atoll, thirty-five miles in circuit. It is composed of a ring of small islands, fourteen in number, surrounding a lagoon, which is some twelve miles long and eight broad. At two places there are deep entrances leading into the lagoon, which, according to Sterndale, forms a splendid harbour, suitable for ships of any draught. The islands are all formed of coral and sand, and nowhere rise more than 50ft. above the sea. They are generally covered with cocoanut, pandanus, and a few other trees, one of which, called *to*, is used for building canoes; and underneath them is found a tall rank grass, called by the natives *hara.* The lagoon was at one time noted for its pearl-fishery; but the quantity of shell has been much diminished of late years, and little is now said to be found there.

The island was first made known to Europeans by Lieutenant Watts, of H.M. transport "Lady Penrhyn," who discovered it in August, 1788, on his way from Tahiti to China.

The United States surveying-vessel "Porpoise," forming one of Commodore Wilkes's fleet, visited the island in February, 1841. From the account of the expedition given by Wilkes I abstract the following notes, principally to show how thickly populated the island was at that time: "The 'Porpoise' stood off and on all night, and on the morning of the 15th February, at sunrise, canoes were discovered approaching the brig in great numbers, many of them large. At seven o'clock two came alongside, and others soon followed them. As the number of the visitors increased they became more bold, and clambered up the sides, uttering loud and savage cries. They were the wildest and most savage-looking beings we had ever seen, vociferating in a frightful manner, and accompanying their exclamations with the most violent contortions and gesticulations: they seemed frantic with excitement. These natives were quite naked, except a few, who had a small *maro* of cocoanut-leaves. . . . On the north-west side of the island there appears to be a continuous village, with cocoanut groves throughout its whole extent, and the island is evidently thickly populated. The ferocity of the savages prevented the possibility of landing."

This brief account reminds us of many similar scenes in other Polynesian islands in their first intercourse with Europeans. The fearless ferocity and daring, so often noticed, and so characteristic of the race, and which was frequently exemplified in the intercourse of the Maori with Cook on our own shores, is well shown here. It required no small amount of courage to board a vessel which was entirely new to their ideas of maritime craft, manned by those whom they looked upon as gods. It is no wonder that, amidst scenes to them so new, their actions should have been looked on by their visitors as violent and vociferous.

The island was evangelized in 1854 by native teachers from Rarotonga, who found not the least difficulty in making themselves understood. In 1864 the island was almost depopulated by Peruvian slavers: Sterndale states that at least one thousand men, women, and children were at that time taken away to South America.

The native name of the island, as stated above, is Tongarewa, which may be translated as "Floating Tonga," or "Tonga floating in Space;" but its ancient name was Fararanga, which is translated by the Rev. W. Wyatt Gill as "Land." A local name for the group was also furnished to Lamont—Te Pitaka, or "The Ring," no doubt in reference to the disposition of the islands on the reef. The nearest land to the island is Rakahanga, distant about 230 miles in a south-south-west direction; and twenty-five miles further off is Manihiki, both of which islands are inhabited by the same race of people, and from whence the first inhabitants of Tongarewa came. A man, named in their traditions as Mahuta, with his wife Okura, were expelled from Rakahanga for some misdeeds, and found their way to this solitary island. From this pair the present inhabitants trace their descent. Tradition says that they brought with them cocoanuts, fish, the *hara* plant, and the birds of the island. The people of Rakahanga trace their origin to Rarotonga, as related in the following tradition, which the Rev. William Gill gives in his "Gems of the Pacific," page 280 :—

"There is every reason to believe that these tribes, both on Manihiki and Tongarewa, separated by six hundred miles of latitude from Rarotonga, came originally from that island. Their appearance, their manners and customs, their language, and their traditions alike lead to this conclusion. As a specimen of their traditions on this subject, we will give one preserved by the people of Manihiki and confirmed by the old people of Rarotonga : 'The first man who came to these lands was Iku. He came from Rarotonga, and landed on Manihiki. On his first visit from Rarotonga this land was scarcely above the level of the sea. He only saw the white surf breaking

over the reef. He then returned to Rarotonga. Afterwards three brothers came in their large canoe; their names were Maui the elder, Maui the second, and Maui the third. These brothers were fishermen. The elder brother let down his hook—his large hook—and caught a fish called *urua;* the second let down his hook—his large hook—and caught a *kakai;* then the third came near the reef and let down his hook—his large hook—and, behold! he drew up the land. In drawing it up, Maui the elder and Maui the second were drowned, and then the third was alone. He landed, and thus the land became his own; but he was alone. At this time it was made known to Iku at Rarotonga that the island had been raised, and that Maui dwelt on it. Iku then came to the island, and, behold! it was even so. The island was high up above the sea. Iku went on shore. Maui and Iku fought. Iku designed to kill Maui; but Maui was great and powerful. In the battle Maui stamped with his foot on the ground. The large island was by this stamp of Maui's foot broken up into many parts, and this is the origin of the many islands in this part of the sea. Immediately on stamping Maui was caught up into the air, and ascended into the heavens, for he was a god. Iku the Rarotongan was then left alone on the land, and he planted the first cocoanut there—his was the parent cocoanut. Iku then returned to Rarotonga. He told to his sister and her husband all he had seen and done in this land. Her husband was a great warrior—his name was Toa; but he was vanquished on Rarotonga. He and his wife put to sea in a canoe. They remembered what Iku had said about Manihiki and all the lands broken by Maui. Toa came with his wife to this land, and, behold! they found it just as Iku had said. The land was here, so were the cocoanuts, even the parent cocoanut from Rarotonga.* Four children were born unto Toa: they were all daughters. These were their names: Vai, Navenave, Pae, and Nanau. This Nanau became Toa's wife, and Te Poriakaivai, a son, was born. Two other sons were born, whose names were Makatangaro and Ikutau. The daughter of Navenave became the wife of Ikutau, and their children were—Te Mokopu-ongoro-tonga, Te Mokopu-ama, Te Mokopu-o-ngaroepe, and also Meau and Vaititiri. This is true. Toa and his wife, from Rarotonga, were the parents of all the people on these lands, and the lands were divided to their children. This is true. The saying is ended.'"

We observe in this tradition that the old story of Maui, so well known in New Zealand and many of the Pacific islands,

* It must be remembered that in Maori and Polynesian traditions or histories the name of the principal actor, or leading chief, alone would be given. We must not, therefore, suppose that this tradition implies that Toa and his wife alone came in the canoe from Rarotonga.

has here again found a local habitation, mixed up with the relation of what, no doubt, is the true history of the first population of the island of Manihiki. This is, no doubt, evidence of the antiquity of the myth, and shows that it was common to all the Polynesians before the great dispersion of the race which appears to have taken place from twenty-two to twenty-eight generations ago. It will be noticed that Iku—or Hiku, as it would be with our Maoris—returned to Rarotonga after his struggle with Maui—a voyage of over six hundred miles—reminding us of the voyages of Kupe and of Ngahue to New Zealand when they *re*discovered this country, and who on their return informed the subsequent immigrants of its existence and suitability as a home for them. To those who have not given much consideration to the question it would almost seem impossible that the Polynesians should have been able to make such extensive voyages as they evidently were in the habit of doing. But the double canoe, or *amatiatia*, which was commonly used, was a craft capable of withstanding very rough weather, and with a considerable capacity of stowage for provisions.* The number of voyages of over a thousand miles in length, now on record, are so numerous and so well authenticated that there is no room left for doubt as to the sea-going qualities of their canoes. Want of water would be one of the great difficulties they would have to contend with on these extended voyages; but with a large supply of cocoanuts they would be able to overcome this difficulty and traverse a considerable breadth of ocean. I believe there was a time in the history of the race when they constantly traversed the central parts of the Pacific Ocean, guiding themselves by the regular roll of the waves driven before the trade-winds in the day-time, and by the stars at night. Judging by the traditions of the race in various islands, the active period of these voyages closed some twenty-two to twenty-eight generations ago, at which time there appears to have been some cause at work tending to a general dispersion of the people; but what this cause was we have not the means of knowing, beyond the traditionary accounts which assign wars as the origin of the movement. We can only account for the fact of nearly every little island in the Pacific either having, or having had, a population, by the ability of the people to traverse great breadths of sea. The knowledge that the Maori has of so many of the islands scattered far and wide across the wide expanse of the Pacific can only be understood in this manner. It is generally known that the Maori traces his origin to Hawaiki, which has been identified with various groups of

* See the Rev. W. Wyatt Gill's "Savage Life in Polynesia," chap. xviii., for a description of the starting of an expedition of this nature.

islands, but is most commonly believed to have been Savaii, in Samoa. I have come to the conclusion that the Maori has since his arrival here given to this word a much more general meaning, and that it is used by him as a comprehensive name for the islands generally. A study of their traditions, ancient poems, and *karakias*, or incantations, will show that they were acquainted with the following islands for certain, and also with others whose identification is at present uncertain: viz., Savaii, Upolu, Tutuila, Apolima, Manono, Nukutere, and possibly Olosenga, in the Samoa group; Tonga, Vavau, and Tofua, in the Tonga group; Fiji; Tahiti, Raiatea, Moorea, in the Tahiti group; Rarotonga and Auau (the ancient name for Mangaia), in the Hervey group; Rurutu, in the Austral group; and not improbably with Rapanui, or Easter Island.* It is also probable that in ancient times the race had a knowledge of the coast of South America. Hiku's voyage, therefore, from Rarotonga to Manihiki, with the favouring South Sea trades, would present no difficulties nor be considered a very serious undertaking for these old sea-rovers, or, as a friend of mine terms them, the "Vikings of the Pacific."

The names of the fourteen islets which constitute Tongarewa are as follows, according to Mr. Lamont: Mangarongaro, Hakahuha, Sararaka (or Hararaka), Tahiti, Motukohiti, Omuka, Te Puka, Matunga, Motumuno, Hangari, Tokerau (at the north-east end. Tokerau in Maori means the east coast), Ruahara, Tautua, Etukaha (?), and a smaller one called Tamata. It is noticeable that one of the islets is called Tahiti, showing probably a knowledge of that island. This is only natural, however, for the Rarotonga people, from whom the Tongarewans sprang, trace their origin to Tahiti and to Samoa.

Lamont was wrecked on Tongarewa in 1853, and he mentions that the only white man, according to the natives' account, who ever landed there before him was so alarmed at the attitude of the people that he attempted to swim off to the vessel from which he had run away, but was speared and killed by the savages. Lamont therefore saw the people before their habits and customs had been altered by contact with Europeans. Some of these customs I have endeavoured to describe below, and to show their similarity with those of the Maori.

* A gentleman whose opinion is entitled to great weight doubts if the Maori ever had such an extensive knowledge of the islands of the Pacific as is here mentioned; but every one of the names given can be found in Sir George Grey's "Ancient Poetry of the New Zealanders" (with slight alterations sometimes, it is true), and most of them in Mr. J. White's "Ancient History of the Maori," the authenticity of either of which cannot be questioned.

RELIGION.

It cannot be gathered from Lamont's account whether the Tongarewans believed in or worshipped the gods common to the Polynesian race, such as Tangaroa, Tane, Rongo, Tu, &c., but that they had some form of rude worship, accompanied with many ceremonies, is evident. The same word, *atua*, common to Polynesia, was applied as a general one, signifying a spirit or god. Of these they possessed four minor ones (the names are unfortunately not given), represented by various objects; two of them being in their attributes malicious, and two beneficent. The latter were supposed to give life and all necessary to maintain it. The visible representation of one of these *atuas* was a long stick with a large bunch of feathers fastened to one end; of another, a piece of wood with a bunch of human hair attached.* Others were made of cocoanut-wood, a wood which, in some form, was generally connected with their superstitious observances. They believe that the spirit, after the death of the body, haunts its former home for some time, and then leaves for distant regions. The stars were supposed to represent deceased spirits. In the case of severe illness the patient was taken to the *marae*, where the priest invoked the *atua* in his favour with many prayers and incantations, finally touching the sufferer with one of the emblematic gods. In the case of death the body was wrapped in mats and taken to the *marae*, to remain there some days, and was then returned to its former dwelling, where it was hung up on the rafters of the roof, the widow remaining constantly with it for lengthened periods in a state of mourning, and *tapu*, or, as the Tongarewans appear to call it, *hui-atua*. After a time the body was buried in the *marae*.

The priests appear to have had great power, and were consulted on all important occasions. The *maraes*, or sacred enclosures, some of which were as much as a hundred yards square, and where all the religious ceremonies were conducted, were enclosed by upright slabs of stone, standing as much as 6ft. out of the ground. Inside were other stones standing on end, said to be tombs. There were several of these *maraes* in different parts of the group, some deserted and evidently not in use for ages. One, at Te Puka islet, appears to have been the most celebrated of them all, and here, tradition says, was the tomb of Mahuta, their great progenitor. Any one entering a *marae* became *tapu*, and could not mix with his fellows until he had gone through certain ceremonies. In

* Mr. John White, in his lectures on "Maori Customs and Superstitions," describes Ihungaru, one of the Maori gods brought here from Hawaiki, as "formed of a lock of human hair twisted with a rope of *aute* (paper-mulberry bark), kept in a house made of wood brought from Hawaiki."

more than one place Lamont noticed remains which did not appear to have been the handiwork of the present inhabitants, but belonged to a bygone age. He says, "Some distance beyond this were what appeared to be the foundations of stone walls, many of them intersecting our path. I afterwards saw similar erections in other parts of the island, but could never get a proper explanation of them, the natives merely saying that they had been houses, but apparently knowing nothing more of them than I did. These remains, like the huge stones of the *maraes* that are evidently made of composition—though the natives believe them to have come out of the sea—led me to believe that another race must have at one time inhabited this little portion of the globe." In another place he says, "I observed that the mound was hollowed out like a cave, and intersected with paths of large flat stones, some lines of which crossed over the summit and descended to the water's edge. The place had at one time been used for some peculiar ceremonies, but of what nature I could never learn."

The *marae*, or temple, is common in some form or other in most of the islands of eastern Polynesia. Cook's description of them at Tahiti will be remembered. They appear always to be connected with the superstitious observances of the people, and are the depositories of the visible incarnation of their gods, and the place where the priests performed their incantations and offered up sacrifices, frequently of human victims. The term *marae* in Maori was formerly applied to a sacred enclosure, but latterly to the open space in a pa and to the courtyard in front of their houses. The *maraes* of Tongarewa were held to be very sacred: no women or children were ever admitted within their precincts except on the occasion of the death of a husband, when the wife or wives were allowed to follow the body and be present when the incantations of the priest were recited.

Personal Appearance and Customs.

The men are described as tall, stout fellows, with brown skins and handsome bushy beards, generally black, but sometimes tinged with auburn, the hair generally long and straight, but sometimes curly. The women were much smaller, with delicate fingers and beautifully-formed hands, and very pleasing in appearance up to twenty years of age. More than one woman is described as having auburn hair and a fair skin, answering to the *urukehu* or reddish-coloured hair sometimes seen amongst the Maoris. Both sexes were virtuous whilst young, in which they differ materially from the usual custom of the Polynesians.

In their habits they were cleanly, bathing every morning in baths formed at the edge of the lagoon, and subsequently in

pools of fresh water, of which there appear to have been several on the islands. They were hospitable and generous, like the Maori, and also, like them, often entertained their visitors till they had exhausted the whole of their supplies. They sat cross-legged, like the Maori, were very talkative, accompanying their conversation with much gesticulation, were easily worked up to a great pitch of excitement, very sensible to ridicule, fond of laughter, and "fickle as the wind." They had great bodily activity, were much given to singing as they paddled over the smooth waters of the lagoon or travelled along from island to island over the reef. Superstitious dread of evil spirits prevented their venturing out at night except in numbers. They did not steal from one another except on organized foraging expeditions, when a dearth of cocoanuts obliged them to make incursions on to a neighbouring island. Fire was procured by friction exactly as the Maoris do, by the use of two sticks, one laid on the ground and held in position by the foot, whilst the other was rapidly passed backwards and forwards till a groove was formed and the dust in it ignited. Counting was performed by pairs, just as with the Maoris.

The men employed themselves in fishing, making canoes, spears, or their household utensils, whilst the women did the cooking, scraping the cocoanut-kernel to prepare *niu wara*—with a shell scraper held exactly in the same peculiar manner that the Maori woman holds the *pipi*-shell to scrape kumara or potatoes. Salutations were performed by the *hongi*, or rubbing of noses, as with the Maori, to which the same name was given. Bathing was the general panacea for all ills, except of a very serious kind, when the priest was feed to exert his influence, and by incantations to remove the cause. They appear to have been almost as much at home in the water as on land. It was the duty of the women to swim out into the lagoon with a basket attached to a paddle, and there dive to great depths for shell-fish, often bringing up the great *paua* or *Tridacna*. Sometimes the whole population of a *kainga*, or village, would surround a shoal of porpoises outside the breakers on the reef, and by their shouts and noise drive them ashore. In doing this the women practised the same custom as their Maori sisters—*i.e.*, placing their elbows near their sides they brought down the hollowed hands on to the surface of the water, causing a loud report.

Marriages were not allowed between relatives nearer in degree of consanguinity than second cousins. Lamont describes a marriage ceremony as follows: "The relatives and people, having taken their morning meal, assembled near the hut of the chief, where the bridegroom was already seated. The bride herself was not visible, custom rather than modesty

compelling her to remain in retirement. The men then formed in a row for the *pihu*, or dance, and the women, before sitting down in front of them, arranged their *tiheis* or petticoats so as not to crumple them, as they prepared to join in the chant. The bride had meanwhile not appeared, and it was not until she had been angrily called that from a closed hut some young girls emerged with what seemed to be a bundle of mats in the centre. This, however, was really the young bride, who, coming forth, ran towards the hut where the bridegroom was seated, and then, darting back, was again enveloped in mats and withdrawn to the remotest corner of the house. The bride does not entirely disrobe herself of matting for several days after the marriage, when she appears with the *tihei*, which she wears constantly for the remainder of her life. Whilst the bride hides herself under the matting, the bridegroom sits in front of the hut, and the ceremony of *pihu* commences, accompanied by an extra amount of crying, cutting, and bleeding, making a most melancholy affair of the happy event. The bride is then handed over to the oldest relatives present for some further ceremonies, which over, the affair is completed." In Mr. Wyatt Gill's "Life in the Southern Isles" is given a pretty picture of a Manihiki bride, which seems to depict much the same dress as here described. The ceremony itself seems to be allied to the Samoan custom on similar occasions—for which see Dr. Turner's "Samoa"—and is more formal than that in vogue with the Maoris.

Of their superstitious ceremonies Mr. Lamont gives several descriptions, one of which, evidently a form of purification to remove the evil effects which might arise from contact with their foreign visitors, was briefly as follows. Part of it appears to be called a *hai*, a ceremony very closely allied to that called by the Maoris *pukanakana*, or *whakatama*—a kind of dance of defiance, accompanied with much grimacing and gesticulation. Lamont and his companions were led to the *marae* by the men, the women and children not being allowed to enter: "Four young men rushed with their spears to the edge of the *marae*, as if about to attack an enemy, facing each other with the most horrid grimaces, and rapidly uttering a kind of incantation. When this *hai*, as it is called, was over, the whole concourse of men hastened within the precincts of the *marae*. Two old priests, girt round with cocoanut-leaves, took seats on either side of the *marae*, some distance further up than the rest. Three young cocoanuts were then placed on the flat stones in front of us, near which stood four young men decked with wreaths of green cocoanut-leaves. At a signal from the priests two of these, stripping pieces of husk from the cocoanut-leaves before them, ran to a point, where they deposited one piece of husk, and immediately darted

back. Each then got behind one of the stones near the priests, and presented the other parts of the husks. This they did in a slow and decorous manner, raising their hands high above their heads and putting the husks down before the priests, who took them with a meek and reverend air, bent over them, and, uttering a low, hurried incantation, threw them over their left shoulders. After repeating this in different parts of the *marae* the whole party advanced to an altar—a heap of rude stones. A youth, having cut three small branches of young cocoanut-tree, plaited the leaves into something resembling the form of a man, and handed them to an old man. On receiving these three gods he ascended the altar, and all heads remained bowed in awe till the ceremony was over. The priest, on ascending the altar, seating himself in front of a large stone while he held the gods in his hands, began to glance round in every direction over the heads of the people before him. A trembling motion, commencing in his hands, extended through his whole body, till every limb shook in a violent manner, the muscles working and veins swelling almost to bursting—a sign that he was possessed by the spirit. After uttering a few incoherent sentences, which subsided into a low prayer or incantation, he lifted his leafy god and struck him violently against the stone, repeating the process with all three. They were then unceremoniously thrown on one side. The three cocoanuts were now removed, and we were marched once more out of the *marae*, and seated outside. Here the nuts, after further ceremonies, were divided and handed to us to eat. The natives then took us to a small pool of fresh water, where, stooping their heads, with a peculiar motion of the arms, they splashed themselves and us all over." They were then taken to a place where the women were, who performed a dance which Mr. Lamont calls a *shukai* or *hukai*, but which from the description is an exact counterpart of the Maori *haka*. Following this was a genuine Maori *tangi*, with the usual accompaniments of cutting the flesh, weeping, wailing, &c.

Another of their ceremonies was called *harahara*, a welcome to strangers, apparently just like the same custom of the Maoris, and in which the Maoris sometimes use the ancient chant beginning, "Hara mai hea, tere tere nui o Tu, &c." *Pihu* (or *piu*, perhaps) was the name given to a chant and dance which is very similar to the Maori *haka* or *kanikani*. In making speeches the men were accustomed to take short runs up and down, and at each turn to pour forth their eloquence, exactly as the Maori does.

The Tongarewans appear to have the same form of *tapu* as elsewhere amongst the Polynesian race; but according to Lamont the word used was *huiatua*, which would mean the

"company of gods," and it is used in this sense in some of the islands. I think it not improbable that Mr. Lamont has, from his imperfect knowledge of the language, misunderstood this word, and used it instead of *tapu*, when it really has the meaning I give above.

At parting they used the words "E hana, e noho," exactly as the Maoris do; the *hana* in this case being the Taranaki *whano*, to go, which in other parts of New Zealand would be *haere*.

According to the Rev. W. W. Gill ("Jottings from the Pacific," p. 147), the sacred fish of these islanders in olden time were the robber-crab, a species of land-crab called *tupa*, the octopus, and the conger-eel. Turtles—called *onu*—and porpoises were eaten only by the men; and the killing of the former, as in so many of the islands, was accompanied with many ceremonies, which Lamont describes. The priest repeated an incantation or prayer over it, apparently to drive out some evil spirit. It was then taken to the *marae*, where further ceremonies were performed, and there beheaded and disembowelled. A fire was then lit, the turtle cooked, and offered on a rude altar to the gods. It was then taken outside the *marae* and eaten by the men, the women showing the greatest horror when part was offered by the Europeans to them. One or more of all fish caught was similarly first offered to the gods before being eaten.

The Tongarewans do not appear to have differed from the Maori or eastern Polynesians in their love of fighting. In this little group of fourteen islets, many only separated from one another by the shallow waters of the reef, it was certain death for the inhabitants of one to trespass on the shores of another, unless in the few cases where they were allied for mutual protection. Each little islet had its *iriki* (Maori, *ariki*), who ruled his tribe and led it in war. Their arms consisted of long, light spears, called *tao*—the same weapon and with the same name as that of the Maori—laboriously split out from cocoanut wood with their shell *toki* or adzes. These were from 12ft. to 14ft. long, and sometimes tipped with fish-bone. They were highly polished with a rasp of fish-skin called a *poirari*. The *koirari*, or club, is made of the same wood, but is stronger, and in shape like a paddle; it was generally ornamented with carving on the blade part. These clubs were frequently used by the women in battle to break the spears of the enemy. It was rare that the women so engaged were hurt by the men of the opposing party. Such was the constant state of dread the people lived in, that they never moved about far from their homes without arms in their hands. Much of the fighting was done in canoes on the smooth waters of the lagoon. The women were sent with

offers of peace—another custom common to these people and the Maoris.

Of their manufactured articles their canoes must rank as the first in importance. They were of all sizes, the largest capable of holding forty or fifty men, and they invariably had an *ama*, or outrigger. They were made of a tree called *to*—not the *ito*, or ironwood, of the other islands, but a much softer wood. A tree from 3ft. to 4ft. in diameter was selected, and then patiently hacked down with their shell *tokis*. The log is then rolled to the sea, where the action of the waves partially softens the wood—sufficiently so to allow the builders to split it up into variously-sized pieces, the longest and narrowest of which is selected to form a keel about a foot broad, rounded at the bottom and hollowed inside. The keel is shaped so as to gradually slope up at either end, terminating above the water in the *ihu*, or bow, at one end. Various pieces of irregular shape are now cut to fit one another, and with them the sides are built up, each piece being carefully rounded off so as to conform to the general contour. They are polished with coral to make them fit, and the edges of each piece are bored with a sharp stone or shell to receive the lashings which hold them together. The joints are cemented together with a preparation of pounded cocoanut-husk steeped in water. The body of the canoe is not built the whole length of the keel-piece, but projecting parts are left, both at stern and bow—the latter to act as a cutwater, which, being bluff, prevents the vessel from sinking in the trough of the seas. The upper tier of pieces has a projecting ledge on which the paddlers sit, whilst in the stern is a raised seat used to steer from. The paddle is long, the blade narrow, and usually carved.

The natives also make *kumetes*, or bowls for their food; cocoanut-shells serving for cups. Their *toki*, or adze-handles, as also their shark-hooks, are made of a hard wood like myrtle. Everything else is formed of cocoanut, excepting their *tuis* (spoons) and *mataus* (fish-hooks), which are formed out of pearl-shell, the former of which are often carved. Their houses appear generally to be mere huts made of cocoanut-leaves, open at the sides; but in the better class mats to lift up and down are used to keep out the wind: in this they correspond with the houses of Samoa. The floors and vicinity of the houses are spread with rounded white pebbles of coral, which gives them a neat and cleanly appearance. The people sleep on mats made from the pandanus-leaves, which they call *kie*. Ropes are made of cocoanut-husk after it has been beaten and soaked, as are also their fishing-lines. The former are called *kaha*, the same as the Maori word for rope. Bags and nets are also made from the same material, and are

called *toto*. A collection of houses is called a *kainga*, the same as in Maori.

Their clothing consists of the universal *maro* worn by the men, made of cocoanut-leaves. The *tihei*, worn by the women, is a garment made of finer cocoanut-leaves, split into strips and fastened on a cord at top, which secures it round the waist and allows it to fall to the knees. The Tahitian and Maori word for the same article of dress is the same. The *pareu* is a short mantle of plaited cocoanut-leaves, narrowed round the neck, and falling over the shoulders to the waist. A large garment called *kahu* (Maori, *kakahu*) is sometimes used as a covering at night. They also make a *pare* (same word in Maori) to shade the face from the sun.

Their diet did not contain much variety. Cocoanut in its various forms was the staple article, flavoured with fish, which was cooked in an oven of stones exactly like a Maori *umu*, or *hangi*. A light meal of raw cocoanut was taken soon after rising, a more substantial one at noon, and the principal meal of the day just before sunset, in all of which they resembled the Maoris. The general name for cocoanut at Tongarewa is *niu*, a word common to most of the islands, with slight variations. In some parts the leaf is called *ni*, and from this I think the Maori derived the name of our only palm, the ni-kau, which may be translated *ni*-only, or *ni*-without—a very natural name to be applied to a palm similar to the cocoanut, but without its fruit. The *niu* has, however, in all the islands various names in its different stages of growth. In Tongarewa they appear to be as follows: In its earliest stages it is called *makomako*. *Vaimanga* is the top of the young fruit before it has become husk; in that state it is eaten by the natives with fish. *Niu-mata* is the half-grown state, with the soft pulp from which is made *niu-wara* (or, as Lamont spells it, *niu-oara*), the common food of the people (*mata*, in Maori, means unripe). The *motumotu* is the ripe nut with the husk still green: from this is made *poe* in the same manner as *niu-wara*, but it has not such a delicate taste. There is a particular kind of cocoanut called *mangaro* (which in Maori means mealy), the green husk of which is sweet-flavoured. Old dried cocoanuts are called *hakari* (*akari* in Rarotonga), from which is made *ororo*, a preparation which is considered a great delicacy. If the cocoanut fails, the people have nothing to fall back on but fish and the drupes of the pandanus, for neither kumaras, taros, nor yams appear to have been known to the people in former times. The Rev. W. Wyatt Gill mentions in one of his works a proposition then on foot to remove the people to some other island, as they were in a state of starvation. The only animal was a small rat, which

was not eaten. It is believed that human flesh was eaten on very rare occasions.

Such, then, are some of the customs of the Penrhyn-Islanders; and I think it will be allowed that they resemble those of the Maori in many remarkable particulars. Sterndale says that the people of Rakahanga, Manihiki, and Tongarewa call themselves *maori*. It is quite probable that this is so, and, though the word cannot be taken as having a racial meaning, it is naturally applied to themselves as distinguished from foreigners. The word may be translated as—indigenous, native, common, ordinary, &c.; and it was possibly never heard of as a racial and descriptive name until contact with foreigners necessitated its use.

In the following list of names of people and words, I have, where necessary, reduced the spelling to the form commonly used in Maori, after a careful study of the sound of each word, as given in the peculiar style of spelling adopted by Mr. Lamont, which is a compound of English and Polynesian. There are, no doubt, errors in some of them, but not, I trust, many. I hope they will prove of interest to the philologist until a better collection is procured, though I fear that is not likely now to occur. It was found by the Rarotongan native missionaries that the language was so similar to their own that the Scriptures, written in Rarotongan, were at once introduced, and from them the people learnt to read and write; and thus probably the native dialect would die out together with the people, who number now but a small remnant of those who lived there thirty-five years ago, in Lamont's time. Sterndale says that at least a thousand of them were taken away by Peruvian slavers to work in the mines of that country. Judging from Lamont's spelling of the words, there are two peculiarities of pronunciation which are worthy of note: the first is, that when the letter "i" follows "t," it has the sound of "chi"—as *tamaichi*, instead of *tamaiti*, as in Maori. It is somewhat strange that the Moriori of the Chatham Islands—separated from Tongarewa by over two thousand miles of ocean—has the same pronunciation of the same letter; and, if we may trust Mariner, the same thing is found in Tonga. The second peculiarity is one we are more accustomed to in the Ngapuhi dialect, but is found in no other tribe in New Zealand. The Tongarewans appear to pronounce the "h" as if it had an "s" before it. This is illustrated in the works of early visitors to New Zealand, where such words as Hokianga, Hauraki, Hongi, &c., were spelled Shokianga, Shauraki, Shongi, &c. Those who know the Ngapuhi dialect will recognise that there is some justification for this mode of spelling, although the sound intended to be repre-

sented is not, strictly speaking, given by the "s," but would be better rendered by a compound of that letter and a "y."

Names of People.

Paetangata, Moshishe (? Moehe), Taranga, Mahuta, Naratairo, Tokarora, Otura, Monitu, Opaka, Pikoke, Terapuna, Taharua, Maukakara, Taneowhare, Turua, Ruperauhe, Te Po, Moana Mauri or Maori, Taha, Tere; Hakamoekakara, Hakaputa, Tangira, Kaipoa, Hihi, Turu, Puhi, Tupa, Pare, and Hare.

List of Tongarewa Words and Maori Equivalents.

Tongarewa.	Maori.	English.
Awai!	aue!	alas!
Akino	kino	bad.
Au	au *and* ahau	I *or* me.
Ava (an outrigger)	amatiatia	double canoe.
Atua	atua	a god.
Aha?	aha?	what?
Arorangi ..	..	foreign.
Ae	ae	yes.
E	e, e noho, e inu	sign of the present tense.
E	he	the article "a."
Etahi (one)	etahi	some.
	tahi	one.
Fono	fono (in Samoa)	a council.
Fibe (a knife) ..	tipi	to cut off.
Hangi	..	hungry (according to Lamont).
Hoe	hoe	a paddle.
Hana	whana *and* whano	to go.
Huiatua ..	huiatua, in Maori, means "the company of gods"	tapu.
Honu	onu *or* honu (in several Polynesian languages)	a turtle.
Hoki	hoki	to return.
Hare	whare	a house.
Hai	..	a welcome.
Hakakikite ..	whakakite	to cause to see.
Hatitiri	whatitiri	thunder.
Hakama ..	whakama	shame.
Hara	whara-whara (?)	a long grass.
Iriki	ariki	chief, lord.
Ika	ika	fish.
Ihu	ihu	bow, nose.
Ino	kino	bad.
Inu	inu	drink.

TONGAREWA WORDS AND MAORI EQUIVALENTS—*continued.*

Tongarewa.	Maori.	English.
Kavio	kavio (in Polynesia)	a crab.
Koai?	kowhai?	who?
Kai	kai	food.
Kaoia	koia	truly.
Koirari	..	a club.
Kakara	kakara	scent.
Kino	kino	bad.
Kumete ..	kumete	a bowl.
Kite	kite	to see.
Ki	ki	at.
Kie	..	a mat of *kiekie.*
Kapa	kapa	a dance.
Karanga ..	karanga	to call.
Kikite	kite (?), kiakite	to see.
Kore	kore	not.
Koe	koe	thou.
Ko (a pointed stick)	ko	a wooden spade.
Kahu	kakahu	clothes.
Kainga	kainga	a village.
Kaha	kaha	a rope.
Maro	maro	a garment.
Marae	marae	a sacred enclosure.
Maitake ..	maitake (in Rarotonga) ..	good.
Makona.. ..	makona	satisfied.
Matua	matua	parent.
Matuaoahine ..	matuawahine	mother.
Manu	manu	a bird.
Matau	matau	a fish-hook.
Makumaku ..	..	cocoanut.
Motomoto ..	..	cocoanut.
Mangaro ..	mangaro	cocoanut ("mealy" in Maori).
Mata	mata	an eye.
Mata	mata	unripe.
Moe	moe	sleep.
Mau	mau	to possess.
Mate	mate	death.
Manga	manga	food.
Mararo	..	flying-fish.
Maumau ..	mama	to leak.
Mai	mai	hither.
Masanga ..	..	to tattoo.
Masanga ..	rahui	to preserve.
Maniniwa ..	..	silence!
Maruanui ..	..	big mouth.
Mou	mo or mou	for you.
Matamata ..	..	beads.
Niu	..	cocoanut.
Niuoara ..	..	cocoanut.
Niumata ..	..	cocoanut.
Noho	noho	to sit, to stay.
Nui	nui	large.

TONGAREWA WORDS AND MAORI EQUIVALENTS—*continued.*

Tongarewa.	Maori.	English.
Na	na	by, of.
No	no	from.
Na	nga	plural form of the article.
Ngahuru	ngahuru	ten.
O	o	food.
Oa	kua	sign of past tense.
Oahine	wahine	woman.
O	o	of.
Oau	au	your.
Ororo		cocoanut.
Oaka	waka	canoe.
Oati		an exclamation.
Oahea	wahea	broken.
Oe	koe	thou.
Pareu	pareu (in Tahiti)	a garment.
Pihu *or* Piu	tangi	a wailing or crying.
Pitaka		a ring.
Puro		husk of cocoanut.
Poirari		a scraper.
Piki (?)	piko	crooked.
Piko	piko	crooked.
Paua (Tridacna)	paua	Haliotis.
Pare	pare	a sunshade.
Poe		cocoanut.
Poro		cocoanut (dry husk).
Puhi		conger-eel.
Rangi	rangi	the sky.
Rua	rua	two.
Rakau	rakau	a tree, wood.
Raurau		driving fish with cocoanut-leaves.
Raro	raro	below, down.
Ruti		a species of fish.
Reihei		a species of fish.
Roa	roa	long.
Sumarenga (?)		the best.
Shongi	hongi	to rub noses.
Shukai	haka (?)	a dance.
Sumaria	humarie	beautiful.
Sakaki *or* hakahi		cocoanut.
Sharashara	harahara (?)	a welcome.
Tihei	tihei	a garment.
Tui		a spoon, a shell scraper.
Tao	tao	to cook, to bake.
Tao	tao	a spear.
Tamaiti	tamaiti	a child.

Tongarewa Words and Maori Equivalents—*continued.*

Tongarewa.	Maori.	English.
Tuahine ..	tuahine	a sister.
Tera-rangi ..	..	foreign lands (?).
To	? tou, *Cordia*	a certain tree.
Toki	toki	an adze.
Toto	toto	a bag, a net.
Tupa	..	land-crab.
Tuka	toka	a rock.
Toka	toka	a rock.
To	to	your.
Tamari (boy) ..	tamariki	boys, children.
Taka oati! ..	..	an exclamation.
Tangi	tangi	to cry.
Tika	tika	correct.
Te'i	tenei	this.
Teina	teina	brother or sister.
Taina	taina	brother or sister.
Te	te	the.
Tane	tane	a male.
Tai	tai	salt.
Tangata ..	tangata	man.
Tibe (a knife) ..	tipi	to cut off.
Tera	tera	"there is," that.
Tukau	tekau (topu)	ten, twice told.
Uto	uto (in Tahiti)	apple of the cocoa-nut.
Vai	wai	water.
Vaevae	waewae	foot.

In the above list of 150 words it will be seen that nearly every one of them is pure Maori, and that they are more akin to that language or dialect than even the Rarotongan, showing, probably, that Toa, the progenitor of the Tongarewans, came from the very same tribe or stock as our Maoris. In conclusion, I would say that the words are taken from Mr. Lamont's narrative just as they occur in connection with the events related. He did not attempt to provide a vocabulary, or doubtless the number would have been very greatly increased.

Art. X.—*Notes on some Relics of Cannibalism.*

By H. D. M. Haszard.

[*Read before the Auckland Institute, 14th October, 1889.*]

Just outside of the south head of Whaingaroa, or Raglan Harbour, between the cliff and the sea, there extends a stretch of sand-dunes some chains in width, and in places from 30ft. to 40ft. above high-water mark.

Some time since, whilst surveying the vicinity, I was fortunate enough to come across some relics of the old cannibal times, a short description of which may prove of interest to the members of this society and the general public. I had heard of bones being occasionally found in the sand, but, on proceeding there one morning after the wind had been blowing for some days from the north-east, I was surprised to find that a great deal of the superincumbent sand had been carried out to sea, exposing what had evidently been the camping-ground of the natives during some of their sanguinary feasts.

In two distinct places, about four chains apart, there were a number of *kapura Maori*, or native ovens, scattered about in no regular order, but each group contained within a radius of about 40ft. Among the stones of the ovens were lying charcoal and the charred remains of bones: the former was remarkable for its fresh appearance, and, as far as looks go, might have been burnt only a few weeks ago. Near the ovens there were great quantities of human bones; in some places being in little piles, with the larger bones split as if to get at the marrow, before being dispensed with by the picnickers. In other places there were odd bones scattered about, and still further away there were some complete, or nearly complete, skeletons sticking up through the sand, which, judging from the size of the frames and the state of the teeth, may possibly have belonged to some hoary old warriors who had looked too tough to be eaten, and had been given their quietus simply to keep them out of further mischief. I also noticed some bones that, from their size, must have belonged to children.

Among the *débris* there were plenty of fish-bones, the *tamure* (*Pagrus unicolor*), *kahawai* (*Arripis salar*), and *kanae* (*Mugil perusii*) being conspicuous, also the *pipi* (*Venus stutchburyi*) and other common shell-fish; so that the feasters had evidently not depended altogether on one course.

I searched carefully to see if I could find anything to throw light on the discussion as to whether the moa was used as food by the natives, but could not see any trace of large bones.

Scattered about on the sand were numerous pieces of obsidian broken into thin flakes. Some of these still retained an edge "keen as a razor," some were serrated, and others, again, were rounded by the ceaseless drift of sand. These obsidian knives must have been brought from some distance, the country immediately surrounding being of limestone formation, and, though the Karioi mountain at the back is trachytic, I never saw any obsidian *in situ*.

There were also picked up some of the ordinary stone axes, and I found a carved bone *mere* (whale bone, I think), but it was broken across the handle, and rather decayed. I did not notice any greenstone ornaments or implements, though, of course, there may have been some buried deeper in the sand.

I made a collection of some of the most interesting things found, including a skull with a specially retreating forehead, and intended handing them over to the museum; but, unfortunately, in moving camp they got lost.

It is difficult to estimate how long ago these feasts took place, but I think it could not have been less than seventy years, probably much more. I made inquiries of some of the old natives living near, and they did not seem to have any tradition respecting the spot, and it was not *tapu* (sacred), as it would have been had it concerned any of their immediate ancestors. The implements, too, point to a time previous to the advent of the white man.

In a few weeks this modern Golgotha was again buried deep in the sand, which will no doubt preserve these interesting remains of a bygone time till a continuance of north-easterly winds again exposes them to the gaze of any observers who happen to be near.

Art. XI.—*Description of a Meteor, of 4th May, 1888.*

By Taylor White.

[*Read before the Hawke's Bay Philosophical Institute, 8th July, 1889.*]

I will endeavour to describe the appearance, or my impressions, of a meteor which was visible in apparent close proximity to my position at Wimbledon, Hawke's Bay, on the 4th May, 1888, between 8 and 9 o'clock p.m. It was the most beautiful and grand sight it has been my lot to witness.

The shortness of time allowed for inspection makes it difficult to fix certain points as to the position of blue and green bands showing in the tail or streamers, but I feel justified in placing them on the outer edge. The nucleus, or head, was of oval form, of a transparent light-yellow colour, as of iron at a white-heat. The tail was in the form of the tail of a pheasant,

expanded—that is, the two centre streamers were of uniform length, and the outer ones gradually shortening, so the outermost streamer on either side was very much shorter than those in the middle. These streamers were of a dull, opaque orange. They were distinctly divided each from each by dark bands which consisted of several fine black lines, to, probably, the number of five in each band. I am unable to fix the number of orange streamers, but would guess ten as probably correct. As the colours blue and green were certainly present, I place them outside the orange streamers—say a band of green next the outermost orange streamer on each side, and beyond, again, a band of blue. Otherwise these colours would have obscured the black lines, if contiguous to them. The head was distinctly outlined and of only the one colour; the tail almost perpendicular, and looking along it was as looking up a ladder. No sound was audible when the meteor was in view, but after I had gone into the house, and was describing what I had seen, the sound of its striking the earth or sea was heard—a loud and lengthened noise, to me like the violent shaking of all the forest trees, and evidently above ground, thereby differing from the sound accompanying an earthquake—coming from the westward; and this was followed, after a hardly perceptible interval, by a fainter sound, like an echo, to the north-east. This place is surrounded by forest trees, which would to a certain extent affect the character of the sound. The time which elapsed till the sound was heard was from three to five minutes. The direction of flight was from east to west, looking southerly. Appended is a sketch which will give an idea of the scene, and several newspaper-clippings, which are interesting as pointing to direction of flight and also as showing the discrepancy in descriptions given by several observers. At the same time it must be borne in mind that numbers of people are more or less colour-blind, and so incapable of giving an accurate description of colours.

Roughly speaking, I should say the line of flight was a little to the south of a line drawn between Herbertville, on the east coast, to Foxton, on the opposite coast.

Newspaper Extracts.

[*Hawke's Bay Herald*, 7th May, 1888.]

Our Waipawa correspondent writes as follows under Saturday's date: Last evening, at about 9.20 o'clock, we were visited by another brilliant meteor. It was accompanied by a loud noise in the air, and there were tremors when it apparently reached the earth, the effect being like an earthquake.

[*Waipawa Mail*, 5th May.]

A very brilliant meteor fell here last night. Its track across the sky was marked by a magnificent blaze of light, illuminating the whole heavens, and lighting the interior of the houses. After the light disappeared, a shock, as of an earthquake, was felt, and some say the meteor must have struck the earth close to Waipawa.

[*Canterbury Times*, 11th May.]

A very remarkable aerolite passed over Palmerston North on 4th May, at ten minutes or a quarter past eight, and apparently fell on the ranges south of the Manawatu Gorge. It was first observed high up to the north, and slowly travelled the whole heavens, its appearance being that of a large globe of pale-green fire, followed by a train of the most brilliant light. Those who were outside at the time watched its course with wonderment; those inside were startled by what looked like a flash of the most vivid lightning, ending with a ball of fire, for so intensely bright was the light that it pierced window-blinds and everything, and made the lamp-light momentarily look pale. The phenomenon was succeeded at an interval of quite a minute by a very distant rumbling, which appeared to be of subterranean origin. Like the aerolite, which was seen by four-fifths of the population, whether they were abroad or not, the rumbling was also apparent to nearly every one. The night at the time was beautifully starlight, and clear down to the horizon, and perfectly calm.

[*New Zealand Mail*, 11th May.]

Masterton, 5th May.

A meteor appeared in the northern sky at 8.30 last night, of great luminous power and rare beauty. It resembled a ship's blue-light, and shot across the sky like a rocket, and then vanished high up without exploding. The phenomenon was supplemented by a slight shock of earthquake.

[*New Zealand Times* (Wellington), 8th May, 1888.]

A correspondent, signing himself "Inscius," sends us the following interesting notes relative to the great meteor of last Friday evening: "Something more than has yet appeared deserves to be said of the wonderful meteor which came to lodge with us on Friday night, and I was disappointed when I took up the *Times* this morning that 'Observer,' or some other competent meteorologist, had not already said it. For my part I was so filled with delight and astonishment (almost amounting to terror) at the marvellous phenomenon, the like of which I have never before seen, that I do not doubt many more beside myself will be interested to hear what science can tell us on the subject. I was at the time strolling home to

town along the Kaiwara Road, and had got to a spot about half-way between the railway bridge and the brewery, when suddenly I was startled by a most brilliant electric light being thrown in front of me. Quickly turning, I saw a sight which I shall never forget—a meteor, whose centre was as brilliantly red-hot as the summer sun at noonday, surrounded by a star-like sheath of electric blue light, the luminous track of the meteor forming a tail of intensely white light,—if my recollection serves me rightly, edged with electric blue. The height at which the meteor was when I first saw it I should estimate at about 40°—certainly not more; and the time it took in making its passage across the sky I should judge to have been somewhere about three seconds. The position at starting was, roughly speaking, over the north end of Somes Island, and at the finish a little to the northward of the starting-point. So near did it seem that I listened for the splash, which the eye led me to expect would occur off Ngauranga, between there and the island. A moment's reflection, however, convinced me that the actual distance away of this beautiful and wonderful object was infinitely greater, and perhaps I heaved a sigh of relief at the thought. To show the effect of its intensity and brilliance, I may say that a person who was near the top of Hill Street said afterwards with some assurance that he at first thought it would strike the Parliament Houses, but that it proved to be further off, and he judged it to have buried itself in the Manawatu Company's reclaimed land. Perhaps he went to look for the hole this morning! The person who told this to me was somewhat astonished at hearing that its effect on me was as related above. I have omitted to say that the apparent size of the star was quite half that of the full moon. I hope that my commonplace observations will draw the meteorologists."

Art. XII.—*Shadow-pictures.*

By Taylor White.

[*Read before the Hawke's Bay Philosophical Institute, 8th July, 1889.*]

Plate III.

Shadow No. 1.

During the last total eclipse of the sun visible in New Zealand I was standing outside the house, in company with my brother, the late Colonel White, viewing the progress of the eclipse, when, happening, in the partial darkness, to take notice of the shadow thrown on the wall under the verandah after the

rays of light had passed through a quantity of jasmine trained on wires along the front of the verandah, to my astonishment all the spots of light showing on the densely-black shade were of a crescentic form, and made a most unique and wonderful pattern. Not one series of rays passing through the jasmine-bush but what took the exact crescentic form, all about the same size; and, more singular still, all the horns of the crescent-forms were directed in a similar manner. To the left of the observer, or eastward, the door of the room opening on the verandah was open, and similar shadows were shown on the far wall of the room, by the side of the fireplace.

The sun was low on the horizon. Unfortunately I neglected to note the exact stage of the eclipse—that is, whether the crescentic form of the visible portion of the sun pointed to the east or west, or if the eclipse was coming on or going off at the time. I am quite convinced that the shadow-crescents corresponded to the stage of the eclipse, and that at the opposite stage of the eclipse these crescentic shadows would all have faced in the opposite direction—that is, westward.

I have no theory to account for this occurrence, but simply record what was plainly visible. Doubting whether or no it were some delusion, I said to my companion, "What do you see on the wall?" when he turned and looked at the shadow, and then said, "All the light spots are crescents." Afterwards, in his presence, I described this scene to Mr. and Mrs. H. K. Hodge and Miss M. E. Worthington, and drew a rough sketch, all of which was corroborated by Colonel White. So that, although these persons did not actually see the shadow, yet they can speak to the fact that Colonel White agreed with me as having himself seen this unusual sight.

When viewing a total eclipse of the sun, which seldom falls to the share of any one person to see more than once in a lifetime, there are so many points of interest and such a short time allowed for observation that one's attention is frittered away in trying to notice too many things at one and the same time. Above all, the observer should be clad as for an antarctic expedition, or he will soon find himself by the fireside and in no way eager for astronomical observation. I noticed ice about an inch thick on buckets of water, formed during the interval of the eclipse. If the time occupied by an eclipse were of longer duration all life would no doubt become extinct in localities under its immediate influence, owing to the intense cold prevailing.

The annexed diagram (Pl. III., fig. 1) will be sufficient to illustrate my description, but gives no conception of the beautiful pattern which was shown, and which, to the best of my ability, I have attempted to describe.

Shadow No. 2.

Scene near Lake Wakatipu, Otago.

The traveller at the foot of the mountain begins to ascend from the valley enveloped in a dense fog, without sign of sun. After an arduous climb he is half-way up the mountain-side, and sits down to rest, but soon starts again on his way, for all is cold, dank, and miserable. After breasting the slope for some time, suddenly he finds that he is, as it were, *standing* on the misty billows, which glisten white in the glorious sunshine, with a beautiful clear blue sky overhead.

The summit of each mountain is piercing through the mist, giving the appearance of numerous islands surrounded by a most beautiful sea of snowy and rounded billows.

Now, supposing the traveller to be standing on a narrow spur, or razorback, leading to the mountain-top, with a hollow curve, or basin, to his right, and the sun to his left, he will, all things being favourable, see his gigantic shadow lying on the mist, and around the head a circular halo of yellow-green, margined with or gradually changing into purple, something similar to that at times to be seen encircling the moon.

I have taxed my memory as to whether I have seen this more than once, which would seem probable, owing to my business at one time requiring that I should be almost constantly on the mountains after sheep; and also if any person was with me at the time. But after the lapse of years I can only connect this shadow-view with one particular place and time, when alone. Also, I was in the habit of always having a dog with me, but I have no remembrance of his being there, or seeing his shadow.

You will see by the accompanying sketch (Pl. III., fig. 2) that the halo did not surround the head, as is shown in old pictures of the saints, with a glory around the top of the head, but was upright, as if a centre was taken near what I may call the centre of eyesight of the figure, and the outer circle of the halo drawn equidistant from that centre, overhead and down towards the shoulders of the shadow, which might be supposed to look through it.

Should there be more than one observer each would probably see his own shadow only; but I have, as I before said, no remembrance of seeing this tested.

To see this is well worthy of a stiff climb up the mountain; but the particular contour of the spur, the elevation and position of the sun, are special requisites, and probably it would be hard to find places specially suitable for showing the shadow.

I wrote on this subject to a relative, now resident in Scotland. In answer he speaks with enthusiasm of the re-

membrance of such a scene when accompanied by a friend, and makes the remark "that probably his dogs would stand too near the ground to throw a shadow."

He omits to satisfy me as to whether he could see the shadow of his friend contiguous to his own.

The place he speaks of was some miles distant from where I locate my position.

Art. XIII.—*On Maori Proverbs.*

By Judge T. H. Smith.

[*Read before the Auckland Institute, 11th November, 1889.*]

At the request of the worthy Secretary of this Institute, I have undertaken to put together a few notes upon a subject which has interested me in years gone by, and which may possess an interest for some of my present audience. I refer to proverbs in use among the Maoris.

When my promise was given I was not aware that the field over which I purposed to range had been already harvested, and I might almost say gleaned, by a more able hand than mine. I refer to a paper by Mr. Wm. Colenso, of Napier, read before the Hawke's Bay Philosophical Institute on the 9th June, 1879, headed "Contributions towards a Better Knowledge of the Maori Race," and printed in vol. xii. of "Transactions and Proceedings of the New Zealand Institute."

After reading this carefully-prepared and valuable paper, I felt that I could add very little to the information it contains. Mr. Colenso gives a list of 235 Maori proverbs, out of a collection of some 1,200 or 1,400, with most of which I am familiar, and he adds renderings into English and explanations of meaning with which (with a few exceptions) I agree.

It was never my intention, however, to attempt the preparation of a list of Maori proverbs—a task which Mr. Colenso has undertaken, and performed so creditably; but it has occurred to me that a comparison of some of them with those in use among other races would prove an interesting study. To attempt such a comparison within the limits of this paper would, of course, be futile. I merely throw out the suggestion. It has struck me, however, as a noteworthy, if not a remarkable, fact that a people like the Maori, separated from the rest of the world for many generations, with life-experiences and surroundings differing so widely from those of other nations, should yet have arrived at the same conclusions, entertained the same views, and given expression to the same sentiments with reference to human experiences in

similar words. It is curious to note how the popular sentiment, the wisdom gathered by experience, matured and handed down through successive generations, has, as it were, crystallized into proverbs so similar in form to those of other races with whom they had no communication or connection.

The life of the Maori in the olden time was so different from what might be imagined by those who have seen him only since the time of his coming into contact with the pakeha and civilisation, that it causes to persons who are able, even imperfectly, to picture what that life was, a feeling of surprise to find that his views regarding conduct in life and the results of observation, his knowledge of human nature, and shrewd perception of what makes for success in the struggle for existence and the securing of a good position among his fellows, are embodied in proverbial utterances so similar to those of his more cultured brethren of the civilised world.

The Maori word for proverb or adage is "whakatau-ki"—"ki," a word or saying; "whakatau," to meet, or, rather, to go forth to meet, as an approaching visitor. The "whakatau-ki" is the *word* put forth to *meet* your interlocutor—almost a challenge. You meet your man with a "whakatau-ki." In making use of a proverb it is generally, or, at least, frequently, referred to as "he whakatau-ki na nga tupuna"—a saying of our ancestors—and in the case of many such a saying is quoted as the words of some particular ancestor—*e.g.*, words said to have been spoken by Houmaitawhiti to the party of emigrants leaving Hawaiki for New Zealand in the Arawa canoe. "E u ki uta kei mau ki taiki Tu, puhia, he angina! e mau ki taiki Noho, ma te huhu e pepe hanehane." Freely rendered, "When you reach your destination follow not Tu, the war-god, or you will disappear as a cloud; but follow Noho, the peaceful home-dweller, and you shall see old age." This is often quoted as a proverb or ancestral saying, and used by way of warning, and urging the advantage to be gained by seeking fame in the field of industry rather than as a warrior.

Dr. Trench, in his "Lessons in Proverbs," says that it is a mistake to assume that "because proverbs are popular they have therefore originated with the populace;" "that the sound common-sense, the wit, the wisdom, the right feeling, which are their predominant characteristics, alike contradict any such supposition. They spring rather from the sound healthy kernel of the nation, whether in high place or in low, and it is worthy of note how large a proportion of those with the generation of which we are acquainted owe their existence to the foremost men of the time."

The conditions and necessities of life required the Maori to be brave, alert, vigilant, fertile in resource, patient, and in-

dustrious. His normal state was that of a man perpetually beset by danger. His life was always in his hand. He was liable at any moment to be called to face an enemy. He must not allow the dawn to find him sleeping for fear of a surprise, or lest he be awakened with the cry, "E ara! e ara! kei patua takototia koe" ("Arise! arise! lest you be slain in your bed"). As a "rangatira" (gentleman, or chief), he must also be hospitable and patriotic in the sense of devotion and care for his own tribe. The most popular and influential chief was the one who was most conspicuous in seeking the welfare of the people before his own personal advantage. Many proverbs inculcate or praise these primitive virtues and denounce their opposite vices. The moral standard of the "rangatira Maori," though not the same as that recognised among civilised nations, was nevertheless a high one, and failure in recognising and acting up to its requirements brought contempt and obloquy upon the offender. The conduct of the chief and leader of the tribe must be "tika"—straight, right, capable of justification according to the recognised code, which no doubt sanctioned deeds very repugnant to our ideas of right and wrong. Differences of opinion as to what was "tika" and what was "he" doubtless were frequent, and led to war, bloodshed, and much misery; still, the fact remains that there was a recognition of the obligation to do the right and refrain from doing the wrong thing, and that the wrong-doer was amenable to a public opinion, and his deed to public criticism and reprobation. The very title of "rangatira" carried with it the idea of honourable, generous, and chivalrous conduct. It is the equivalent of the English word "noble." *Noblesse oblige* was recognised by the Maori chieftain as fully as by the *noble*man of any other nation. Even in matters of mere etiquette the "rangatira Maori" was quite as particular as his well-bred brother of any other nationality, nor did his code in these matters differ very materially from those existing in communities with far higher pretentions to good-breeding and refinement.

I have selected from the proverbs collected by Mr. Colenso, and others which have not found a place in his list, a few which may serve to support and illustrate the assertion that the "tangata" Maori's notions of right and wrong, his ideas of worldly wisdom and expediency, of prudence as the guide of his conduct, and his perception of duties devolving upon him as a member of a community mutually dependent one upon another for the maintenance and promotion of the common weal, were not greatly dissimilar to those of civilised races who have enjoyed greater privileges.

Among Maori proverbs, probably the most numerous are those contrasting the results of energy put forth in the production of food and material wealth, enabling their possessor

to achieve fame for hospitality, with the results of energy expended in warlike pursuits. But the wisdom enshrined in these proverbs, though unquestioned and generally acknowledged, did not suffice to repress the martial spirit of the young men, or to neutralise the attractions of the war-path and the battle-field. These had a charm which was wanting to the quiet life of peaceful industry which the proverb eulogized. Death on the battle-field was regarded as more becoming to a man of spirit and in every way preferable to a death from sickness or old age—"mate kongenge," or "koeo" — meaning worn-out, decayed. The proverb commending peaceful pursuits as preferable to warfare might be upon the lips of the wise old men, and pass current generally, but the desire of the young man was to seek the fierce excitement of the conflict and to taste the

> stern joy which warriors feel
> In foemen worthy of their steel:

showing that, with the Maori as elsewhere, precept and practice were often at variance.

The proverb was often used with great effect during discussions of important matters by the chiefs at public meetings. A proverb aptly and opportunely brought in would serve to clinch the argument of the speaker, and would carry his audience with him so completely that the matter in debate would be practically settled. Skill in the use of these proverbs, and in references to old traditions and songs—"waiatas"—composed to perpetuate the memory of some event or incident in the past history of the tribe, was one of the most valued accomplishments of the Maori orator.

As a specimen of a proverb contrasting the fame of the warrior with that of the energetic tiller of the soil: "He toa taua, he toa pahekeheke; he toa mahi kai, ekore e paheke" ("The fame of the daring leader of war-parties is precarious, slippery; not so the fame of the energetic cultivator of the soil"). Another: "He toa taua, ma te taua; he toa piki pari, ma te pari; he toa mahi-kai, ma te huhu tena" ("A leader in war will fall in war; a daring scaler of precipices, a precipice will be his death; a stout subduer of the soil, the worm will get him"—he will die a natural death).

Some of the proverbs are pregnant with deep meaning: "He tao rakau, e taea te karo; he tao ki, ekore e taea te karo" ("A shaft of wood—spear—may be parried, but not a shaft of the tongue"). Again: "He kokonga whare, e kitea; he kokonga ngakau, ekore e kitea" ("The corner of the house may be explored and seen, but not the corner of the heart"). And "He ta kakaho, e kitea; ko te ta o te ngakau, ekore e kitea" ("The pattern of the reed lining of the house may be

followed by the eye, but not the pattern or figuring of the heart").

There are very many proverbs in praise of industry, and holding up the lazy and indolent to scorn: "Taane rou kakahi, ka moea; taane moe i roto i te whare, kurua te takataka" ("Husband clever in getting the kakahi [a fresh-water shell-fish] shall be loved; husband who sleeps his time away shall be cuffed"). "Tama tu, tama ora; tama noho, tama mate kai" ("Son up and doing, prosperous son; son sitting, hungry son").

Some of the proverbs are very severe upon greediness and gluttony, &c., and are rather plain-spoken than elegant: "Hohonu kaki, papaku uaua" ("Deep in throat, shallow in muscle"). "Tohu noa ana koe, e Rangikiato, he whata kei te kakii" ("Dost fancy, O Rangikiato! thou hast a food-store in thy throat, that thou art stowing away food there at that rate?"). "He kai ko tau e pahure" ("A good trencherman—feeding is the work you are best at"). "To kaha kei te kaki, karapetau tonu" ("Thy strength lies in thy throat—thy feats are feats of swallowing").

Proverbs directed against those who claim to share in the products of the labour of others, having shirked their share of that labour: "I whea koe i te tangihanga o te riroriro?" ("Where were you when the riroriro sang?"—in the spring, or planting-time). "I whea koe i te ngahorotanga o te rau o te kotukutuku?" ("Where were you when the leaf of the kotukutuku fell?"—in the autumn and winter, when the forest is felled to make a new plantation).

There are also proverbs relating to neglect or missing of opportunities: "E kore te patiki e hoki ki taua puehu" ("The flounder does not return to the place he left when disturbed"—The same chance will not present itself twice). "He manu ka motu i te mahanga ekore e taea te whai" ("The bird which has escaped from the snare it is vain to follow").

A talebearer is often checked and rebuked by a proverb—thus: "Ko korua pea ko Tama-arero i haere tahi mai?" ("You and Mr. Tongue's son travelled here together perhaps?"). "I haere mai pea koe i te kaainga i a Te Arahori?" ("Have you come from the settlement of Arahori?"—lying path, or path of lying). "Na Tangokorero pea koe i tono mai ki konei?" ("Mr. Newsmonger sent you here, perhaps?").

Among miscellaneous proverbs, I have selected a few showing a discriminating appreciation of things worthy of admiration or reprobation: "He pai kai, ekore e roa te tirohanga; he pai kanohi, e roa te tirohanga" ("Choice food gives but a passing gratification; a pleasing countenance a more lasting one"—A thing of beauty is a joy for ever). "Kotuku kai

whakaata; parera apu paru" ("The beautiful white crane feeds daintily; the duck gobbles up the mud"—A man is known by his tastes). "Ruia tai tea; kia tuko taikaka anake" ("Shake off the sap-wood; let only the heart stand"—Get rid of the half-hearted and depend only on the sound-hearted) (Hearts of oak). "Homai te kaeaea kia toromahangatia; ko te kahu te whakaora, waiho kia rere ana" ("Take the little mischievous sparrowhawk, but leave the large hawk alone"): Said of a man of inferior rank, as being more wicked and dangerous than the chief of high rank.

Making use of a friend's services and neglecting to serve him when it is in your power to do so: "He karanga taua, ka karangatia Paeko; he karanga kai, te karangatia Paeko" ("A call to the fight—Paeko is called; a call to the feast—Paeko is not called"—One good turn deserves another, but is not always remembered). "He kuku ki te kainga, he kaka ki te haere" ("A dumb pigeon at home, a screeching kaka [parrot] abroad"—does not welcome the traveller to his village, but when travelling himself blusters about expecting everybody to minister to his wants). "Maramara nui a Mahi kei riro i a Noho" ("Let the big slice go to Worker, lest Loafer get it").

Proverbs teaching promptness: "Kei te kamakama te tikanga" ("Promptness carries the day"). "Mata, whiwhia; maoa, riro ke" ("Uncooked, and secured; cooked, and confiscated"—Eaten underdone, you get it; fully cooked, somebody else may. Bird in the hand worth two in the bush). "Hohoro te kai ma tatou; akuanei tu ana a Raeroa noho ana a Raepoto" ("Hasten your meal: presently Raeroa [High-brow—the superior] will stand up here, and Raepoto [Low-brow—the inferior] will have to sit down or give place [take a back seat], and we shall lose our meal"). "E mua, ata haere; e muri, whatiwhati waewae" ("Those before—first on the road—may travel leisurely; those behind, who start later, must hurry up at the risk of breaking their legs") (The early bird).

Proverbs showing the advantage of self-reliance and independence: "He kai tangata, he kai titongitongi kaki; he kai na tona ringa, tino kai tino makona noa" ("Food, the product of another man's labour, sticks in the throat; food, the product of your own labour, is partaken of with zest and eaten to the full").

In praise of energy and perseverance: "Tohea! ko te tohe i te kai" ("Be strenuous—persevere! it is a struggle for food"). "Tukua kia eke ki te paepae poto a Hou" ("Hold on; wait till he [the enemy] touches the threshold of Hou's house").

There are proverbs condemning rashness and premature

action, and commending prudence, circumspection, and forethought: "Mate wareware te uri o Kaitoa; takoto ana te paki ki tua" ("The offspring of Kaitoa perished needlessly in the storm, and the calm lay just the other side of them"—Had they waited but a little they would have escaped disaster). Forethought: "Hapainga mai he o mo tatou; kahore he tarainga here i te ara" ("Bring food for the journey; there will be no fashioning of bird-snares on the way").

Friends plentiful in prosperity and few in time of need: "He koanga, tangata tahi; he ngahuru, puta noa" ("In the planting-season visitors come singly; in harvest-time in crowds"). "Whakapiri ngahuru; tu ke raumati" ("Closely attached at harvest-time; standing aloof in time of scarcity—summer").

The use of irony was well understood: "E noho, ma te au o Rangitaiki koe e kawe" ("Sit still—don't hurt yourself! Rangitaiki's tide [or current] will carry you smoothly and easily along") (Rangitaiki River, in the Bay of Plenty) (*Laissez faire*). "Kei uta nga tai o Riripa tu ai" ("Riripa's prowess will be seen when we get on shore"): said of a lazy fisherman who takes nothing. "He is waiting till we get to shore to show what he can do."

There are many proverbs in use among the Maori people which require a knowledge of the localities in order to be understood. Thus, a man throwing his spear at his antagonist says, "Ana, te kai o Tama Tahei ki a koe!" ("See, a bit of Tama Tahei's food [or play] for thee!"): Tama Tahei being the name of a manuka grove whence the shaft of his spear was, or might have been, taken. The other, successfully parrying the thrust, replies, "Ehara! Kei tua o Kapenga e haere ana" ("Never! It has passed the other side of Kapenga"): Kapenga being the name of a flax-swamp whence the flax, the material of his buckler, might have been procured. Another: "Ka tere Rauwa, ka tere Pipiwhakao" ("Rauwa and Pipiwhakao are afloat"): Rauwa and Pipiwhakao are islands off the east coast covered with trees standing close together, and the proverb is used with reference to a fleet of canoes filled with armed men on a war-expedition, or any large gathering where there are crowds of people. Another instance: There is a rather amusing proverb used in the Lake district ridiculing a person who makes great show in giving an insignificant present to another. The words are: "Kei runga Matawhaura, kei raro Korokitewao" ("Matawhaura is above, Korokitewao below below [very much below]"): Matawhaura is a high cliff which rises abruptly from a pretty strip of sand (Korokitewao) on the eastern shore of the Rotoiti Lake. The idea is, the side of the basket containing the gift towering above the contents lying at the

bottom, as Matawhaura towers above Korokitewao. ("Montes parturiunt, et nascitur ridiculus mus." The Heidelberg tun.)

There are proverbs in use indicating characteristic peculiarities of different tribes—in fact, almost every tribe has one or more of such proverbs: "Ngatipaoa, taringa rahirahi" ("Ngatipaoa of the thin ears"): By which is meant that a distinguishing trait in the character of this tribe is sensitiveness to slight or insult—easily offended by a word. "Waikato tamioha-rau" ("Waikato of the hundred heroes, or great ones"—As a tribe having a great number of illustrious chiefs). "Ngatiawa kowhao rau" ("Ngatiawa of the hundred holes, or hiding-places"—As a tribe difficult to dislodge, or as fertile in resources). Rangitihi, upoko whakahirahira" ("Rangitihi the arrogant, haughty-headed one"). "Rangitihi te upoko i takaia ki te akatea" ("Rangitihi the hard-headed—the aka-bound head").

It may be said that there is scarcely an incident or circumstance in Maori life which has not a proverb to fit it. It is amusing sometimes to listen to two or three adepts in the use of proverbs sparring together, giving and taking the most severe cuts with perfect good-humour: "He aha ma te kopiri nei?" ("What has this little go-by-the-ground to say?"). "Nui puwhawha; iti kahikatoa" ("Yes, big and squashy; little and tough, as the kahikatoa"). "Ko te kai mau e pahure ne" ("You are all there, at the trencher"). "E toe mai ranei ia koe?" ("Will you leave anything?"). "Kei pakaru te taha raumati" ("Take care of that summer-grown calabash of yours [thin skull]"). "Kia ata whakawiri i te ngehingehi" ("Gently there! don't twist your ngehingehi too tightly"): said of a singer who tries to squeeze out a high note. The "ngehingehi" is used to express the oil of the titoki-berry by twisting, and when twisted tightly makes a squeaking noise.

I will close my selection of specimens of the Maori proverb with one which shows that the Maori realised and acknowledged the advantage which the gentler has over the sterner sex in the matter of personal attractions. He has this proverb: "He pai tangata, ekore e reia; he kino wahine, ka reia" ("The handsome man will not be run after [have admirers of the opposite sex], while the plain [or ugly] woman will be run after [have plenty of lovers]").

ART. XIV.—*A Mysterious Therapeutic Agent.*

By E. A. MACKECHNIE.

[*Read before the Auckland Institute, 22nd July, 1889.*]

READERS of the "Nineteenth Century" magazine will have found in the number for December last a remarkable paper entitled "Faith Healing as a Medical Treatment," which must have created a good deal of astonishment in the minds of most of them. The title of the paper strikes one as being somewhat misleading; for, instead of healing by faith, it treats of healing by suggestions made to the patient whilst in the hypnotic sleep, with which "faith" apparently has little or nothing to do. The entire process, as practised by a Dr. Liebault for the last thirty years, and its results, are very fully set out, and doubtless the statements made by the writer are put forward after careful observation, and with a due regard to their truthfulness. From his statements we gather that the doctor sends his patients to sleep by telling them "to shut their eyes," "that the light is failing," "that his voice is becoming indistinct to them," and other signs of approaching sleep, till they actually do fall into the hypnotic state, and become obedient to his word. If the patients are very susceptible it is sufficient to tell them to go to sleep, and they drop off at once—sleep being induced more readily after every visit. Whilst in this state the doctor suggests to his patients that any pain they may be suffering from shall cease, that aching in any part of the body shall disappear, and so on in accordance with the nature of each complaint. This treatment is repeated every morning for several days, and (*mirabile dictu*) all that the doctor has foretold or suggested comes to pass. Appetite is restored, circulation improves, and the disease (whatever it may be) is removed or cured.

Now, it is generally, but not universally, allowed that suggestions made to persons in a normal state of health, either awake or asleep, have no remedial effect whatever. Accepting, then, the recorded statements as the result of careful observation by a competent witness (a medical man, I believe) of the phenomena attending these almost incredible cures, our first inquiry turns to the consideration of the means by which they are effected, and we ask, what is the nature of the hypnotic state, or sleep? The characteristics attending it, in its various stages, are described as follows: First stage, torpor of limbs, and general somnolence; second, resembles catalepsy, limbs remaining in any position, however strained, they may be placed in; third and fourth, patient becomes deaf to every voice except the operator's; fifth and sixth, more

advanced states of automatism; seventh, absolute forgetfulness of all that has occurred during the sleep; eighth, patient entertains any hallucination suggested to him by the operator. All this may be, and doubtless is, perfectly true; but these external appearances throw no light upon—in nowise account for—the singular mental and bodily condition into which the patient is thrown. Let us glance briefly at the history of the phenomena.

There can be little doubt but that the very singular condition into which the animal body can be brought by what is now known as the hypnotic sleep, or trance, was familiar to many nations, and was practised for the purposes of deception or otherwise, long before Mesmer's time. But Mesmer was, I believe, the first to induce that condition in public, and to employ it as a curative agent. His theory in explanation of the phenomena was a remarkable one. He professed to believe that the heavenly bodies diffuse through the universe a subtle fluid which acts upon and influences the nervous system of all animals. By that influence he could, he averred, effect a painless cure of all diseases by the simple process of making a few passes. His *modus operandi* was to receive his patients in a richly-furnished room, pervaded by perfumes, and echoing soft music. He suffered them to remain there undisturbed for some little time: their senses became lulled, all nervous agitation subsided, and then Mesmer himself appeared, waving a magic wand. Probably he performed a kind of incantation scene on these occasions, which may fitly be described in the words of Shelley's "Magnetic Lady to her Patient"—

> "Sleep, sleep on! forget thy pain.
> My hand is on thy brow,
> My spirit on thy brain,
> My pity on thy heart, poor friend;
> And from my fingers flow
> The powers of life, and, like a sign,
> Seal thee from thine hour of woe.
> * * * * *
> The spell is done. How feel you now?
> Better?" "Quite well," replied
> The sleeper.

That was the process and the result, for under this treatment many of his patients fell into the mesmeric state, and were cured, or professed to be so, of their maladies. Other operators induced the same phenomena by using magnets, and Mesmer, not being able to obtain the influence of the heavenly bodies at command, resorted to the use of magnets himself. He was very successful, but his success was not due to the heavenly influence, nor the magnets, nor the operator himself, but to the soothing surroundings which lulled his patients to sleep. His practice became so large, and his fame so great,

that members of several scientific societies, by order of the French Government, examined into the matter very carefully, and after a most lengthened investigation reported strongly against the system—in fact, Mesmer was branded as a quack. Science so pronounced itself in those days—justified, no doubt, by its then knowledge. But, as mesmerism was used not only as a curative but as an anæsthetic, under which surgical operations were performed without sense of pain to the person operated upon, it is equally clear that science erred in the conclusion arrived at. It certainly would have been more in accordance with the facts of the case and the spirit of scientific inquiry if those statements had been somewhat less emphatic than they were. They had a most injurious effect upon Mesmer's practice: he disappeared, and died without revealing his secret. Mesmerism then fell into the hands of persons who were far from reputable, and its professors were regarded as schemers and sharpers.

Many years after Mesmer's death a new theory of the morbid phenomena was enunciated, which was called animal magnetism. Much was written about this new discovery, and its extraordinary effects upon certain persons, and the cures effected by its use. Successful operators were reported to have a strong will, a superabundance of nervous energy, and great power of concentrating it so as to affect persons possessing a weaker organization or a highly nervous temperament. The spell was cast over consciousness by the operator making a variety of passes with his hands around the head and neck of the patient. Some writers averred that, on the passes being made, a stream of animal magnetism, odic or vital force, or whatever else they chose to call it, was seen to flow from the operator's fingers towards the patient; and this was implicitly believed. Not content with these marvels, writers on the subject introduced to the public a great variety of mediums and ethereally-constituted clairvoyants, who could see with spirit-eyes, and give a detailed account of events which happened in the past, or would happen in the future. They read the smallest type or closest writing with ease on having the paper placed on the pit of the stomach, or the forehead, or the back of the neck. They claimed to possess the remarkable power of not only leaving their own bodies, but of entering that of any other person and giving a minute account of the health or disease of the body so invaded. Their spirits could roam over the entire earth, make known the most secret things among mankind, confer with the spirits of the dead, and bring back messages to the living. All this, and more, was attempted to be established by the solemn declarations of many well-known persons, made in due legal form, and attested by a notary public. I have read in wonder

many of these testimonials, no little stir being made at the time by the so-called discoveries in animal magnetism.

But, whilst faith in animal magnetism was still unshaken, and the daily Press teemed with accounts of extraordinary cures, famous séances, and wonderful clairvoyant visions, Dr. James Braid, of Manchester, England, explained most of the phenomena as due not to odic, mesmeric, vital, or any other force, but as simply the result of psychological or physiological laws. The operator, he stated, need possess no special gifts of mind or body, and the phenomena were due solely to an unusual degree of "concentration of attention," mental and visual, in the person affected. His patients were asked to look steadily at an object on a level slightly above their heads, or were soothed by gentle sounds, by the hair being lightly brushed, by being walked slowly about the room, or suchlike means, when incontinently they fell into what he called the hypnotic slumber. Other operators, though adopting these views, varied slightly their modes of inducing such sleep, by directing their patients to look fixedly at a bright glass button held by themselves some 8in. from, and just above the level of, their eyes. Persons carrying out their directions were found after a brief time to be more or less profoundly affected. "Concentrate one's attention," says Dr. Braid, "upon an object to the exclusion of all else, and the result will follow as a matter of course." That was his opinion; but many operators deny that concentrated attention is an essential factor in those abnormal states, or that such a conception of hypnotism is by any means established, or that it explains many facts attending it. Be it as it may, these experiments completely disposed of the magnetic influence; and when, after some time, it was found that some persons could acquire the peculiar faculty of hypnotizing themselves, the delusion of a force emanating from the operator vanished altogether. Of late years we have all heard much of electro-biology, table-turning, spirit-rapping, and such like eccentricities, which, though they imposed for a time upon the credulous, were rightly ascribed by the thinking portion of the world simply to a juggler's sleight of hand, or to concerted tricks in which electricity played no inconsiderable part.

Science, as you know, throws out explorers along every conceivable line of thought; and they record, publicly or privately, the course they have pursued, the difficulties they have encountered, the experiments they have made, and the conclusions they have arrived at. Many of these conclusions prove subsequently to be incorrect, but they tend in no small degree to inform the general mind and lead to more important discoveries. The gradual advance in astronomical science, though the conclusions were in many respects based in error,

led Newton to a very clear perception of the laws of gravitation; and the enlarged field of observation in natural history enabled Wallace and Darwin to arrive at the theory of natural selection and the doctrine of evolution. The same holds good in all other departments of science, especially that relating to mental action and the subtle relations existing between mind and matter. Now, the study of mind-phenomena may be approached from either the psychological (sometimes called the metaphysical) or the physiological side, according to the bent or constitution of the inquiring mind. My own psychological studies have not been sufficiently deep or extensive to enable me on that side even to hazard an explanation of the difficulties presented by hypnotism, though many persons, I must tell you, maintain that the cause of the phenomena is essentially psychic. I am thus driven by the limits of my information to adopt the statements of physiologists, and offer for your acceptance a solution of the problem from their point of view. But before doing so I think it well to mention the extent of my own actual experience, that you may not be misled, or induced to give me more credit than I can justly claim. Many years ago I had an opportunity of ascending a platform, in the presence of a large and highly respectable audience, and submitting myself to the power or will of the operator, who practised what he called "electro-biology." I did so with some fifteen others. Having seated us in a long row fronting the audience, he placed a metal disc in the hand of each, telling us at the same time to look steadily at it and keep our minds as unoccupied and free from thought as possible. To the best of my ability I carried out his instructions, staring in a vacant manner at the disc for about ten minutes. I was not in any way affected, though I am bound to say three or four of our number were so within even a less period. Those affected apparently believed everything suggested to them. They were made to play the most ridiculous antics, and to perform many extraordinary feats. But, as you have all probably seen persons under this singular influence, I need not further describe what was done. My knowledge is obtained from reading, therefore, and not from direct contact with facts. So much that is personal to myself I have considered it necessary to state, that I may not be misunderstood, or seem to claim greater originality than I am entitled to. Mine is the more humble office of examining the statements of others, and endeavouring, out of much conflicting testimony, to arrive at *some* conclusion, however imperfect or unsatisfactory it may prove to myself or others. I need only add that I shall endeavour to convey to you my meaning with as little aid from technical expressions and scientific terms as possible.

There is abundant evidence of the fact of an abnormal condition—however induced—called mesmeric, magnetic, or hypnotic. That cannot now be disputed; and we are led to ask, what is its nature, and how is it produced? Braid maintains that hypnotic and natural sleep are analogous; and we consequently inquire, what induces sleep? Observers of the brain during sleep aver that it is paler than it is during ordinary waking hours. There is considerably less blood in it, and its functions as an organ of animal life are suspended. "The possibility of artificially inducing sleep at any time in a person by simply withholding from the brain all stimulation by means of the senses has been frequently tried and realised. Thought-activity ceases, the brain lies dormant, and a bodily state is produced which naturally leads to and engenders sleep." Now, writers on hypnotism state that by concentrating the attention on some particular idea, and excluding all other ideas, the circulation in the brain becomes less active, and the individual passes into sleep. And this appears to be borne out by the general practice of mankind. When wakeful of nights, we all think of, and mentally repeat, a few monotonous words, and continue doing so, to the exclusion of all other thought, till the brain becomes less active, and sleep follows. From all this we may, I think, fairly conclude that in the hypnotic slumber the quantity of blood flowing through the brain is less than the ordinary quantity, and, being less, there is less consciousness; for consciousness is said to be the result of the activity of the brain occasioned by a supply of blood circulating through it with healthy regularity. And this is so far proved, for if we lessen the supply of blood we at once reduce brain-action. If the supply is cut off the brain-functions are entirely suspended, and the animal falls into a deep coma. Restore the flow of blood, and consciousness and brain-functions are restored. Now, Dr. Beard, of New York, compares common consciousness to a large chandelier with all its jets lighted, but burning dimly; while inducing the hypnotic state is like turning off all the jets but one, which burns all the more brightly. Or it may be likened to a complicated machine thrown out of gear, and all its parts motionless save one small part, which revolves and acts as usual. Hence consciousness is said to be normal only when many different impressions are acting upon it; but when these impressions are restricted—"when certain large parts of thought are sunk in forgetfulness or torpid indifference"—it is held to be abnormal. This last is its condition in the hypnotic sleep.

We may next inquire, what persons are usually affected, or thrown into the hypnotic condition? It appears that the child-mind, or the uninformed and inexperienced mind—which is nearly related to it—is easily affected. This I ven-

ture to call the "receptive mind," for it receives without hesitation, doubt, or examination every idea presented to it, adopts and acts upon it as if it had originated within itself. Hence the best hypnotic subjects are taken from the working-class, stupid burly soldiers, and youthful persons. All these are accustomed to obey without resisting, or even having an opinion of their own. They are simply automatic machines, obeying without thinking. But the mind which rejects each thought presented from within or without, carefully examining before adopting it, is not found to yield itself readily to the operator's will. Hence the higher-educated class are not easily influenced; and if they refuse to concentrate their thoughts, or concentrate them to resist the suggestions of the operator, they are not hypnotizable. The estimate is, that only about one person in twelve can be hypnotized.

Now, I will ask you to imagine the patient far advanced in the hypnotic state; his sense of taste, touch, colour, and temperature entirely lost; the forms before him indistinct, the eye immovable, and himself unconscious. Yet whilst in this state the sense of hearing remains on the alert, the auditory sense does not slumber. The same phenomena, it may be observed, appear during somnambulism. At any noise the somnambulist pauses in whatever he may be doing, and listens intently: if all is quiet he continues to walk, or proceeds with what he was about. Why the portals of the ear should be open while all other senses and mind-powers are dormant, and why open to the operator's voice alone, I am unable to discover. The mind of the hypnotic sleeper is said to come into communication with that of the operator; but the statement affords me no explanation of the difficulty. The patient, being, then, in the state I have described, is found to believe what is said to him by the operator, and to obey all his commands. The thoughts and ideas suggested by the operator take, apparently, complete possession of the patient's brain, and control his will, his brain being reduced to the condition of an imitating- or repeating-machine. That is the explanation I shall endeavour to make clear to you. The statement that I am at present reading was prepared hurriedly to meet an emergency—a promised paper for this evening not being forthcoming—and the time at my disposal did not admit of my looking for an article on hypnotism which I am told appeared recently in one of the English magazines. I must therefore proceed with my explanations without the aid I might have derived from its perusal. Now, it is not essential to what I have to say that I should dwell on the different substances composing the brain, or its division into parts, or the localisation of its powers: it is sufficient to know from those who have examined its structure microscopically that much of it

consists of nerve-cells and nerve-fibres, there being, it is said, a thousand million of cerebral cells, and about three times as many nerve-fibres connecting them. The nerve-cells produce and accumulate nerve-force; the fibres, like telegraph-wires, conduct the current to any place required. Impressions from without are conducted by certain nerves to the brain, and we become conscious of them. Another set of nerves transmits the impulse from the brain to different parts of the body, and is connected with the muscles, and calls them into action.

The brain has been compared to a galvanic battery in which an electric current is generated, the nerve-force being said to resemble electricity, for a current of electricity passed along a nerve produces the same effects. "The conductive system of the nerves," says Sir William Armstrong, "is in keeping with our conception of an electrical arrangement. In fact, a description of the animal machine so closely coincides with an electro-dynamic machine actuated by thermo-electricity that we may conceive them to be substantially the same thing." All this is mere elementary knowledge, which I venture to recall to your minds in the hope of making subsequent explanations more intelligible. Now, the hypnotized brain, you will remember, is shut up and dormant except to the voice of the operator. His voice, like all sounds, produces air-waves; these enter the ear of the patient, and, after vibrating through the inner chambers of that organ, "are finally converted into impulses, which act as irritants of the ends of the auditory nerves." The nerve-element is said to be in a state of equilibrium when undisturbed by any impulse; but when so disturbed the impulse travels along the nerve to the brain, creates vibrations more or less powerful in certain nerve-cells, rouses into activity portions of the cerebral apparatus, and there follows an involuntary exercise of the faculties in obedience to the impulse given. In the hypnotic sleep certain cell-territories seem to be thrown into some peculiar receptive condition, and the suggestions of the operator set in immediate motion the automatic forces latent in the brain. You will bear in mind also that the intelligence and volitional power are not only asleep, but less capable, by the circulation of a diminished quantity of blood through the brain, of withstanding the vigorous brain-action of the operator. The patient is in the condition of a machine with its own motive-power withdrawn, and a stimulus from without substituted, by which it is made to move and perform its usual work. As Edison's recent invention, the phonograph, retains the sounds impressed upon it, and reproduces them in a mechanical way, so the human brain, set in motion by the operator's voice, performs many of its functions in the same mechanical manner. That is my view of the involuntary and unconscious acts of the patient in

obedience to the commands or suggestions of the operator—they are purely automatic.

Accepting this explanation for what it is worth, we have now to consider the operator's suggestions as operating as a remedial agent. It is known to us all that there is interaction of mind and body, and that certain states of the mind injuriously affect the body. Grief and fear act most forcibly, and the effect of those passions can easily be traced in our appearance. In like manner the mind is affected by the unhealthy state of some bodily organs, and those afflicted become sad, depressed, or irritable, as the case may be. "If a morbid direction of the imagination can cause disease, the reverse may aid in curing it." Now, suggestions are said to be effectual in diseases of slow development, such as affections of the brain, of the nerves, of the digestive system, and especially in rheumatism, paralysis, or hysteria, but to have no effect in reconstructing what disease has destroyed, or in staying the course of acute maladies. Have the suggestions any therapeutic value whatever? I can only say cures by this means, though singular, seem to be well authenticated, but no exact scientific explanation of the phenomenon can be obtained. How or why a patient is influenced to his cure is as yet a mystery.

The researches into the nervous system of our bodies, particularly the nerve-element which constitutes the brain, presents to some minds the greatest of all possible attractions. The chief aim of those who pursue them is to gain a more intimate knowledge than we have at present of that wonderful and complicated structure. The study engrosses their every faculty. With all the ardour and sustained hope of those who in former days sought to discover the philosopher's stone, they strive to fathom not only the secrets of life, but the nature of life itself. They toil

> To win
> Something to satisfy the thirst within—
> To *know* something here!

For it is felt that within the unexplored regions of that complex and elaborate nerve-system the great mystery of the relations between mind and matter—their constant and inexplicable actings and reactings upon each other—lies hid. Nerve-tissue, we know, increases in complexity in ascending to more and more highly-organized types of animal life, and we can well conceive, if the volume and complexity were greatly increased, our mind-perception would be increased also. But it would not add to the general happiness. The nerve-sensibilities of men of genius are frequently so acute as to render themselves and those around them far from happy and content. The life of Irving Bishop would seem to confirm this. He was an irritable and unpleasant person to be with,

or have dealings with, but his powers of mental vision were certainly most remarkable. An examination of his body before —or after—death (whichever it was) disclosed a more than ordinary development of nerve-tissue, and this would seem to account for his most extraordinary powers. Anatomists and physiologists, like other students of nature and her wonders, are frequently misled, and come to unwarranted conclusions, for nature's most subtle workings, especially in the animal kingdom, are concealed with so rare a cunning that it baffles the research of the most skilful and diligent investigators. But the patient inquiries of these silent workers, like the action of earthworms, are entirely beneficent. They are frequently rewarded by being able to place at the disposal of the medical world the means of alleviating the physical sufferings of mankind. If we trace the history of their discoveries from the days of rude surgery—when after the amputation of a limb there was no known means of staying the hæmorrhage except by cauterising the stump with hot iron—to the marvels of the present day—to the use of anæsthetics, and of hydrochlorate of cocaine, by whose deadening influence the most delicate operations in ophthalmic surgery can be performed without pain to the patient—we must acknowledge their services with the profoundest feelings of gratitude. These researches into "the fountains of our deepest life" appear to many well-meaning persons as impious. The study of the wondrous mechanism of the human brain, and its functional activity in health and disease, is frequently regarded even at the present day with as much hostility as necromancy and dealings in the so-called "black art" were of old. Every effort made to unravel the mysteries of conscious being is condemned as sinful, to be punished by extreme mental and bodily suffering,—

> Yet all too little to atone
> For knowing what should ne'er be known.

But surely such persons err. The reverent study of the glorious perfection of Creative Will is man's true homage. He therein recognises, however imperfect the revelation may be, some of the attributes of the universal man.

What is this subtle and mysterious agent that paralyses the strong will, and compels the nerve and muscular sense to obey, in an unreasoning and mechanical way, the dictates of another mind? If in the hands of a beneficent person it can be made to act as a remedial agent to relieve bodily suffering or mental distress, it is capable of being used also, it must be admitted, by the malignant and unscrupulous to gratify the worst feelings or the basest passions. The operator, by threatening torture, may compel obedience to unlawful commands; or sug-

gestions may be made to execute criminal acts, and the unfortunates, powerless to resist even when their better judgment is awake, may carry them out to their fullest extent. The possibilities of this new agent appear unlimited, and so fraught with danger to the welfare and happiness of mankind that the aid of the Legislature in France and elsewhere is sought to control and regulate its practice. And if this is true—if the suggestions of one mind can sway another to all that is immoral or criminal, if our natural gifts can thus be held in abeyance, and the machinery of our inner life be moved by the animal energy or the ideas emanating from another mind—what becomes of our personality—the Ego, as it is called—and all its responsibilities? Startled at the momentous question and all that it implies—bewildered—we mutter with the musing Macbeth,—

> Can such things be,
> And overcome us like a summer's cloud,
> Without our special wonder?

ART. XV.—*On Terrestrial Magnetism.*

By the Hon. ROBERT HART.

[*Read before the Wellington Philosophical Society, 19th February, 1890.*]

OBSERVATIONS on the subject have determined that the magnetism of the earth is that of a hollow sphere. The problem here proposed for solution is the constitution of that hollow sphere.

The earth, an oblate spheroidal mass, having a diameter at the equator of about eight thousand miles, travelling through space at the speed of about nineteen miles in a second of time, is held in its place toward the sun by the centripetal and centrifugal action of its gravity in motion.

While so travelling and so kept in its place the earth revolves upon its axis in rather less than twenty-four hours, carrying with it on its surface an elastic cushion, called its atmosphere. This atmosphere consists of air containing oxygen and hydrogen gases interfused with a trace of a third. Observations on the aberration of light have determined the depth of this atmosphere from its outer surface to be between forty-five and fifty miles. That to the depth of forty miles from its outer surface this atmosphere is absolutely dry must appear from the fact that water in a state of vapour would at that distance from the surface of the earth lose the heat needful to keeping it in that state. Even at his place of observa-

tion on the Peak of Teneriffe, Piazzi Smith found the desiccating power of the atmosphere such that the ink he used in writing would often dry in the pen during its passage from the inkstand to the paper; and those of his instrument-boxes which were fastened with glue came in pieces, from the moisture necessary to its holding-power being dried out of the glue, and the glue converted into powder.

That dry air is a non-conductor of electricity was proved fifty years ago at an exhibition in what was called the Adelaide Gallery, in London, where the discharge of the electricity stored in an enormous Leyden jar through a column of dry air in a glass tube caused it to pass as a ball of white light, occupying an appreciable time in its passage; while a similar discharge through a similar tube from which the air had been withdrawn poured as a stream of purplish light. This proves that dry air offers, *pro tanto*, obstruction to the passage of electricity, which the absence of air freely permitted. Dry air, being a non-conductor of electricity, must, in the same way as glass, sealing-wax, and dry brown paper—non-conductors of electricity—be a good electric, and, subjected to appropriate conditions, generate electricity.

Faraday demonstrated that oxygen gas is magnetic—that is, acted upon by electricity it acquired polarity in the same sense as steel does.

This cushion of electric matter carried round the earth in its diurnal revolution cuts the lines of physical force which hold the earth in its place toward the sun while travelling through space at rates varying from a thousand miles an hour to nothing. That a process analogous to friction must be the result is a reasonable conclusion, deriving confirmation from the existence of the trade-winds and the Gulf Stream. That the earth's atmosphere, revolving at such speed, and exposed to the action of those actively-acting lines of physical force, could be so exposed without a physical effect being produced, is a conclusion which I cannot believe.

This effect upon the dry atmosphere is the generation of electricity, which, acting upon its oxygen, gives magnetic force directly to so much of the oxygen as is directly subject to the electrical action, and by induction to any not so subject. And thus is constituted the hollow sphere to which are due the phenomena of terrestrial magnetism.

The view here put forward is confirmed by the coincidence observed between the appearances of spots on the sun and those of the aurora borealis and aurora australis on the earth. Spots on the sun are produced by the rolling-away from over large surfaces of that luminary of the cloudy envelope, his photosphere. The effect of such rolling-away is to intensify the action of the sun's gravity upon the earth's

atmosphere and to abnormally excite the magnetism of its oxygen. This abnormally-magnetized oxygen, in the usual circulation of the air occasioned by the heat of the tropics flowing over towards the poles and becoming condensed, discharges its abnormal electro-magnetism in light.

The fact of the earth's atmosphere being thus rendered self-luminous suggests the probability that the luminosity of the sun is due to the friction of the planets rolling round him acting upon suitable materials.

I am persuaded that, when opportunities of observation have been afforded, and the facts are ascertained, it will be found that the magnetic poles of the earth are not fixed in position, but movable. They are nearest to the axial poles of the earth at the times of the equinoxes, and farthest from them at the times of the solstices.

The electro-magnetism of the earth's atmosphere on trees, plants, and animals has a vitalising influence. Upon trees and plants it operates by aiding the circulation of the sap. In man it influences the animal spirits. This can be proved by observation. The southerly breeze in this City of Wellington brings its oxygen into a normal electro-magnetic state. The breeze coming from the north in its passage over trees and plants has parted with some of its electro-magnetism, and is not so refreshing. Still more noticeable is the effect on a day of cloud and fine rain—for then trees and plants, rendered by the moisture which clings to them more than usually good conductors of electricity, are drawing from the atmosphere its electro-magnetism and almost visibly growing, while man and other animals are dull, and, as far as they are liable to be affected by weather, dispirited.

In high latitudes the strength of men is not only due to the warm clothing and oleaginous food the consumption of which helps to keep up the animal heat, together with the action of the oxygen of the atmosphere upon the blood, but is also to be attributed to the electro-magnetism of that oxygen, which, while the air at a temperature many degrees below freezing-point is being inhaled, acts upon the nervous system, quickens the circulation of the blood, and vitalises the system.

II.—ZOOLOGY.

Art. XVI.—*Further Notes on* Coccididæ, *with Descriptions of New Species from Australia, Fiji, and New Zealand.*

By W. M. Maskell, F.R.M.S., Cor. Mem. Royal Society of South Australia.

[*Read before the Wellington Philosophical Society, 2nd October, 1889.*]

Plates IV. to IX.

Since the publication of my book on the scale-insects of New Zealand a few new species of this family have been brought under my notice, chiefly from localities which I have not been able to visit, and from trees on which I could make no personal observations. In addition, some insects have been sent to me for identification from New South Wales and from Fiji, and I have included them in the present paper.

I have to tender my thanks to Mr. G. Bennett, of Sydney; to Mr. R. L. Holmes, of Bua, Fiji; and to Messrs. R. Raithby and T. Cavell, of Inangahua, New Zealand, who have very kindly sent me numerous specimens from their respective localities. Mr. Holmes has sent me a fine collection of Coccids, Aleurodids, and Aphids; and the two last-named gentlemen have been specially assiduous, and have spared no trouble in their assistance to me.

Group DIASPIDINÆ.

Genus Mytilaspis, Targioni-Tozzetti.

Mytilaspis grisea, sp. nov. Plate IV., fig. 1.

Female puparium light-grey, narrowish, elongated, slightly curved, convex, rather solid, about $\frac{1}{12}$in. long; mussel-shaped; pellicles rather small.

Male puparium similar, but much smaller, averaging not more than $\frac{1}{14}$in.; not carinated.

Adult female dark-red, or nearly black, elongated, of the normal form of the genus. Abdomen ending in four inconspicuous lobes, of which the two median are rather the largest; only a few spines on the edge. Pygidium with five groups of spinnerets; upper group with 4–6 orifices; lateral groups, 12–15; several single spinnerets. Length of female, about $\frac{1}{14}$in.

Adult male unknown.

Hab. In Australia, on various species of *Eucalyptus* and on *Acacia*, sp. My specimens are from New South Wales.

There is little beyond colour to distinguish the female of this species, when extracted from the puparium, from several others of the genus; and colour is probably not of much account. However, the dark-red of this insect is uncommon; but the light-grey solid puparium is not likely to be mistaken for any other. From the numbers of specimens on the twigs sent to me I should imagine that the insect must be somewhat plentiful.

Mytilaspis pallens, sp. nov. Plate IV., figs. 2–4.

Female puparium light greyish-green, elongated, flat, thin; rather widely pyriform in many specimens, narrower in others; straight or very slightly curved. Pellicles small; length averaging $\frac{1}{9}$in.

Male puparium resembling that of the female, but much smaller and a little more convex; not carinated. Length about $\frac{1}{30}$in.

Adult female very dark-brown or purple; general form normal of the genus, the cephalic region comparatively large. Abdomen ending in two lobes, with a median depression between them, and several much smaller, usually six on each side; on the edge some rather strong spines. All the abdominal segments bear strong spines at the edges, the last above the pygidium having six or eight. Pygidium with five groups of spinnerets, which often appear as a continuous arch: upper group, 11–14 orifices; upper laterals, 14–20; lower laterals, 18–24; many single spinnerets.

Adult male dark-brown; length, exclusive of the abdominal tubercle and spike, about $\frac{1}{50}$in. The spike is very long, equalling (including the tubercle) three-fourths of the length of the body. Antennæ rather thick, hairy, with ten joints; otherwise presenting no special features. Feet also rather thick; digitules fine hairs.

Hab. (?) My specimens were sent to me from New South Wales, on a species, apparently, of fan-palm grown in a greenhouse; but I am unable to say what is the ordinary food-plant.

In the margin of the abdomen, in the lobes and median depression, and in the arrangement of the strong spiny hairs, especially those on the abdominal segments, the female of this species approaches to the New Zealand form *Mytil. phymatodidis*, Mask., which is common here on ferns; but the puparium differs considerably in size, in colour, and in texture, being much more solid; and the spinneret-groups also differ. The male of *M. phymatodidis* has not yet been observed. Perhaps the great proportionate length of the abdominal spike in the male of *M. pallens* may be a distinguishing character.

Mytilaspis citricola, Packard.

Aspidiotus citricola, Packard ("Guide to the Study of Insects," 1870, p. 527).

Mytilaspis citricola, Packard (Comstock, "U.S. Ag. Rep.," 1880).

This insect occurs on the rind of some oranges forwarded to me by Mr. Raithby, of Inangahua. The oranges, as I understand, came originally from Fiji, and the species must therefore be added to the Fijian fauna. My specimens have perhaps a slightly broader and thinner female puparium, and a rather lighter colour than the type. But, after comparing them with undoubted specimens of *M. citricola*, forwarded to me by Dr. F. Löw, of Vienna, I have no doubt of their identity. They seem, indeed, to be a good example of the necessity, as I think it, of neglecting in the Diaspid group mere outward appearance, and relying chiefly on microscopic differentiation. If only the colour and form of the puparia were taken into account it would be easy to make half-a-dozen species of the specimens on a single piece of orange-peel.

Genus DIASPIS, Costa.

Diaspis santali, mihi, "Scale-Ins. of N.Z.," p. 47.

This insect has in the last three or four years replaced and almost driven out *Aspidiotus camelliæ* on *Euonymus* and *Acacia* trees about Wellington. The two may still be found together sometimes, *A. camelliæ* being much the less frequent: usually *D. santali* has taken complete possession, the trees only suffering the more for the change. It is also appearing on a good many native trees in various places—*e.g.*, *Carpodetus*, *Vitex*, *Melicytus*, &c.

Genus CHIONASPIS, Signoret.

Chionaspis dysoxyli, mihi, "Scale-Ins. of N.Z." p. 55.

In the last twelve months two curious facts have occurred in connection with this insect, one of which is, as far as I know, unique. First, although up to 1889 I had not detected the species on any other plant than *Dysoxylon spectabile*, in February of that year I found it occurring somewhat plentifully on *Melicytus ramiflorus*, in the Wellington public gardens. In March the numbers on *Melicytus* seemed to have considerably increased; and all through the winter these trees became covered with masses of *Chionaspis*, not only on the leaves but also on the twigs and branches, until suddenly, in August, the insects disappeared as rapidly as they had come. They left the plants considerably dilapidated by their attacks, although these had lasted only so short a time, and that chiefly in winter: at the same time, it happened that the winter of this

year was extraordinarily mild and dry. This disappearance of theirs was, indeed, so sudden that, whereas in July, when procuring specimens of male pupæ for hatching, I could have carried away untold thousands, in August I could scarcely find any, and had to hunt over a good deal of ground to procure a dozen infected leaves of *Melicytus*. I cannot offer an explanation of this peculiar invasion and departure. A similar circumstance, but in a much less pronounced way, was noticed by me in 1879 in the case of *Lecanium hesperidum* (see "Trans. N.Z. Inst.," vol. xii., p. 292): that insect, in a dry season, had become considerably lessened in numbers; but its appearance and disappearance were not by any means as peculiarly rapid as those of *C. dysoxyli* in 1889.

The second and much more curious fact in connection with the insect is the emergence of a number of *apterous* males. I had not the male of the species before this year, but, finding the male puparia on *Melicytus* so numerous, I collected many, with a view to procuring the adult. The result was that I was able to hatch them out as follows: In February, four; in March, eleven; in May, eight; in June, sixteen; in July, eleven; and in August, two. I was particular in taking note of the numbers at the time I procured them, because the occurrence of an apterous male at once arrested my attention; and for the same reason I am particular in recording them now. I know of no similar instance amongst Coccids of any group: no observer has, I believe, recorded the existence of an apterous male, unless the extraordinary statements of M. Moniez ("Comptes Rendus de l'Acad. des Sci.," February, 1887), regarding males of *L. hesperidum* existing within the abdomen of the females can be accepted as positive. All male Coccids have hitherto been considered as having two wings: there is a case reported by Dr. Signoret ("Essai," p. 320) of *Gossyparia ulmi*, where the male has "rudimentary elytra," but Signoret himself doubts whether the insects he saw were really adult.*

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* In the August, 1889, number of Professor Riley's excellent publication, "Insect Life," which has just reached me, Mr. L. O. Howard gives a very full description of *Gossyparia ulmi*, which seems to have lately invaded European elms in America; and he figures both the male with rudimentary wings mentioned by Signoret, and the fully-winged male which also emerges from the cocoons. It seems, therefore, that *G. ulmi* and *C. dysoxyli* are two insects with abnormal males; the difference being that in *G. ulmi* males with rudimentary wings emerge only "a few days," according to Mr. Howard, before the fully-winged forms, while in *C. dysoxyli* males entirely wingless emerge for several months before the winged form appears.

While this paper is in the press I have received a note from Mr. Newstead, of the Grosvenor Museum, Chester, England, stating that he has bred both apterous and winged males of *Chionaspis fraxini*. Perhaps, now that attention is directed to the point, other observers may note similar occurrences.

But here is an instance of a large number of certainly adult males without the least semblance of a wing. I hatched, as observed just now, fifty-two males from February to August. Of these, only one, which emerged on the 26th August, was winged. This particular specimen has the wings developed in the usual style, and is in all respects a normal Diaspid; all the other fifty-one were absolutely apterous. I cannot look upon this as a normal state of things: there is nothing in the conditions of the female *C. dysoxyli* to lead one to expect a variation in the male of so fundamental a nature. Yet, considering that my specimens were so numerous, and that they emerged at various times during a period of seven months, I think the fact of their apterous form is of importance.

I append the following description of the male :—

C. dysoxyli: Adult male bright-red in colour, of the normal form of *Diaspidinæ;* length, exclusive of abdominal spike, about $\frac{1}{50}$in.; the spike is about half as long as the body. Head normal; eyes, four—two dorsal, two ventral. Antennæ of nine joints, the first two very short, the next six subequal and as long as the first two together, the ninth shorter and fusiform; all the joints are hairy. Feet normal, hairy, rather thick; digitules fine hairs. Wings, where present, normal, but many specimens found entirely apterous.

The nine-jointed antennæ may here be a distinguishing character: I know of no other Diaspid male with less than ten joints.

Genus FIORINIA, Targioni-Tozzetti.

Fiorinia asteliæ, mihi, "Scale-Ins. of N.Z.," p. 58.

Trees of *Pittosporum tenuifolium*, in the garden of the Club, Wellington, have been this year covered with great numbers of small white puparia, which at first sight might easily be taken for those of some species of *Chionaspis*, but which prove to be male puparia of *F. asteliæ*. Here and there a few females occur, but very sparingly; more than 90 per cent. seem to be males. The twigs of the plants are quite white with them.

Group LECANIDINÆ.

Subdivision LECANIDÆ.

Genus LECANIUM, Illiger.

Lecanium chirimoliæ, sp. nov. Plate IV., figs. 5–15.

Adult female very slender, long, and narrow; length averaging nearly $\frac{1}{8}$in.; width from $\frac{1}{20}$in. to $\frac{1}{12}$in.; colour light-brown (sometimes with a greenish tinge), faintly marked with irregular darker patches. Body very convex above, quite smooth, concave or flat beneath; usually much attenuated

towards the extremities; rather thin and translucent towards the edges. Margins bearing short, fine hairs, not set closely together. Viewed dorsally, the eyes appear near the cephalic extremity; viewed ventrally, the antennæ are placed a long way from the extremity, and the rostrum, between the first pair of legs, is almost at half the whole length. Epidermis exhibiting small, sparse, oval spots, very inconspicuous, irregularly arranged. Mentum uni-articular. Eyes duplex; outer portion orbicular, slightly prominent, yellow, resting on a broadish black base. Spiracular spines not longer than the rest. Antennæ slender, of seven joints — the fourth the longest, the third next, the first fifth and sixth the shortest, the seventh fusiform and bearing several hairs. Feet slender; the tibia is slightly dilated at the end, and bears a spine; upper digitules fine hairs, lower pair somewhat dilated. The abdominal cleft is very long and narrow; the two dorsal lobes small, rather sharply triangular, and closely adjacent.

Second stage of female resembling in general form and colour the adult, but smaller and flatter; length averaging $\frac{1}{12}$in. Antennæ of six joints.

Larva light-brown, elongated, elliptical; length about $\frac{1}{36}$in., convex above, flattish beneath; not clearly segmented; on the margin a few hairs, the spiracular spines no longer than the rest, as in the adult. Antennæ of six rather thick joints, subequal, the third joint a little the longest; all the joints dilated at the ends, except the last, which is fusiform; a few hairs on all the joints, and on the sixth several, of which four are very long—as long as the whole antenna. The feet present no special features.

Male unknown.

Hab. In Fiji, on both bark and leaves of chirimoya—*Annona (Chirimolia) tripetala*.

In colour, and in the sparse markings of the epidermis, this insect resembles *L. hesperidum*, Linn.; but from its elongation and slenderness it belongs to that series of the genus *Lecanium* of which Signoret takes *L. persicæ* as the type. It differs, however, from all described species of that series. *L. elongatum*, Sign., is much larger, is rugose at the edges, and has, moreover, eight-jointed antennæ; so also has *L. genistæ*, Sign. The long, narrow abdominal cleft of *L. chirimoliæ*, the sharp adjacent dorsal lobes, and the short spiracular spines seem to be specific distinctions; and the distance of the antennæ from the cephalic extremity is also peculiar. I am not aware whether the chirimoya is a plant indigenous to Fiji: if it has been imported there from Central America it has probably brought its Lecanid with it.

Group COCCIDINÆ.

Subdivision ACANTHOCOCCIDÆ.

Genus SOLENOPHORA,* gen. nov.

Female insect constructing a test which is prolonged, either at or near the abdominal extremity, in a hollow pipe or spout; apodous when adult; anal tubercles present and prominent.

The clearly distinct anal tubercles of both the insects about to be described fix the position of this genus in the *Acanthococcidæ*. In one species the pellicle of the second stage is employed as part of the adult test, as in the Lecanid genus *Lecanochiton*, mihi; but, as this does not seem to be the case in the other species, I cannot found a generic distinction on it. In *S. fagi* the female of the second stage is undoubtedly apodous, like the adult; and probably this is the case also with *S. corokiæ;* but I have not been able to satisfy myself entirely as to this latter, and therefore have left this character also out of the generic description. Should the two insects, however, hereafter prove to be equally apodous in the second stage, the character will become generically important.

The tube or spout which forms the peculiar feature of this genus is rather a puzzle. I can only guess that it has some sexual function for facilitating the access of the male; yet it is not easy to see the necessity for it, even for that purpose. For many other Coccids in the genera—for example, *Mytilaspis, Ctenochiton, Planchonia*—are just as well shut in and protected as *Solenophora*, and yet have no such peculiar appendage. But, if it has not a sexual function, it is not easy to make out what other object the tube can serve. In the Australian group of the Brachyscelidæ the males of some species are found to inhabit small pipes springing from the galls formed by the adult females: sometimes a dozen or more are attached to a single gall. But in *Solenophora fagi* the male pupa inhabits a felted cylindrical sac quite distinct from the female test; the presence of the tube is therefore not clearly intelligible.

Solenophora fagi, sp. nov. Plate V., figs. 1–18.

Adult female brown, or sometimes inclining to purple; somewhat pegtop-shaped; length about $\frac{1}{20}$in.; the median region very convex dorsally, with somewhat flattened edges; ventral surface flat. Covered by a shield or test of an elongate-conical form, or limpet-shaped, of which the apex is occupied by the pellicle of the second stage, the remainder being waxy; colour of test brownish-yellow, the pellicle darker and rather shiny; test marked with very fine concentric horizontal lines, and a few vertical striæ, of which four are usually whitish;

* Gr. σωλῆν = a tube or spout.

length of test about $\frac{1}{14}$in.; edges somewhat incurved below, so that the insect is partially enclosed. In the majority of cases (though there are specimens without it) when the test is viewed sideways there is seen to project from it, a little above the abdominal extremity, a kind of curved tube or pipe, like the spout of a teapot, hollow and open at the end, and bent downwards. Where this tube is absent the edges of the test at the abdominal extremity are slightly turned upwards, leaving a small space under the test. The female at first fills the test, but at gestation shrivels up; it contains usually a large number of eggs. Insect elliptical in the cephalic and thoracic regions, and smooth, tapering with inconspicuous segments to the abdominal extremity, which is rounded with a short, roundly-conical prolongation; the anal tubercles spring from the ventral surface, near the base of this projection, close to the anogenital ring, and are therefore not visible when the insect is viewed dorsally. Tubercles short, rather slender, each bearing a short strong seta. Insect entirely apodous. Antennæ reduced to mere irregular rings with a few short hairs. Mentum dimerous. Anogenital ring simple, with six short hairs. Spinnerets of two kinds—some circular orifices, others cylindrical tubes. They are most numerous at the edges and at the abdominal extremity.

Female of the second stage red or reddish-brown, somewhat more elongated than the adult, rather convex; length about $\frac{1}{35}$in.; in the beginning of this stage it is slightly covered with loose yellow cottony secretion, which later on becomes a felted, semi-waxy, white test. Entirely apodous. Antennæ atrophied, being reduced to a single-jointed conical process, very short, bearing a few hairs at the tip. Mentum dimerous. Anal tubercles short, but more conspicuous than in the adult, not being covered by any projection of the abdomen; each bears a short seta and a strong spine. Spinnerets of two kinds—some simple circular orifices, others slightly protuberant, double, or figure-of-8; the former all over the dorsum but not numerous, the latter very numerous at the edges and on the abdominal region; from these spinnerets spring some short, white, curly tubes. The female in this stage, having no feet, cannot move; in changing to the adult form the white thin test gradually breaks away, leaving the pellicle to form the apex of the adult test, as before stated.

Larva reddish-yellow, elliptical, flattish; length about $\frac{1}{40}$in.; segmented; active. Anal tubercles very short, setiferous. Antennæ of six short subequal joints; no hairs except on the last joint. Feet rather thick; tibia shorter than the tarsus; upper and lower digitules slender knobbed hairs. On the edge of the body is a row of the large, slightly-protuberant figure-of-8 spinnerets, and also a row of small circular

orifices, and on the dorsum there are four other longitudinal rows of small circular spinnerets. Mentum dimerous.

Male pupa entirely enclosed in a cylindrical yellowish sac of closely-felted secretion. Length of sac about $\frac{1}{16}$in.; length of pupa about $\frac{1}{25}$in. Pupa red, apodous, elongated, narrow, segmented, the segments obscure except the last four or five; exhibiting at the abdominal extremity two short anal tubercles.

Adult male unknown. I have made unsuccessful efforts to hatch any from several specimens of the pupa.

Hab. In New Zealand, on *Fagus*, various species. As yet only from Capleston, Inangahua, where it seems to be plentiful.

This is in several respects a curious and interesting insect. The employment of the second pellicle in the adult test is a character not hitherto reported of any member of the group *Coccidinæ*. From the absence of the feet in the second stage it results that the insect is not likely to be found far from the spot on which it emerged as a larva. The larvæ of most Coccids prefer to seek their sustenance, if not on the leaves, on the young shoots of a plant; accordingly, I understand from Mr. Raithby, who originally found the species, that individuals are rarely found on wood more than a year or so old. It must happen also that two or three larvæ congregate together about the time of their metamorphosis, and the resulting second-stage females, not being able to get away, change also to the adult form in the same place; and so we find now and again two or three adults crowded together or piled on each other. In a specimen of a heap of this kind in my collection the lowest insect has excreted a small quantity of dark-pink cotton round the edges of its test: as I have not observed this in any other amongst some scores of individuals examined, I cannot take it as normal. As regards the spout-like tube, it is to be noted that the prolongation of the female abdomen would, in the test, pretty nearly correspond to the inner opening of the tube.

Solenophora corokiæ, sp. nov. Plate V., figs. 19–24.

Insect constructing a pear-shaped, smooth, waxy test, which is prolonged at the abdominal extremity in a short tube, either straight or slightly turned upwards: this tube is at the extremity itself, and not a little above it as in the last species. Colour of test brownish-yellow; length about $\frac{1}{15}$in. The second pellicle does not appear to be employed in the test.

Adult female brown; length about $\frac{1}{20}$in.; pegtop-shaped, the cephalic and thoracic regions large, abdomen tapering to the anal tubercles, which are of moderate size and setiferous;

the tubercles are visible in dorsal view, as the abdomen is not produced cylindrically as in *S. fagi*. Feet entirely absent. Antennæ atrophied, simply irregular rings bearing hairs. Mentum dimerous. Spinnerets of two kinds, some simple and circular, others figure-of-8: these last seem to be more numerous, especially on the dorsal thoracic region, than in *S. fagi*.

Female of second stage, larva, and male not observed.

Hab. In New Zealand, on *Corokia cotoneaster*, a twisted shrubby plant in river-beds, Reefton district.

The distinction between this and the last species, at least as far as the adult female is concerned, is marked by the form of the test, the position of the tube, and the absence of the second pellicle.

Genus Rhizococcus, Signoret.

Rhizococcus totaræ, sp. nov. Plate VI., figs. 1–11.

Adult female naked, dark-brown, elongated, at first elliptical but later somewhat shrivelled; length about $\frac{1}{25}$in.; cephalic region proportionately large, smooth; body tapering to the abdominal extremity with conspicuous segments; anal tubercles distinct, but small, with very short setæ. Antennæ of six (frequently five) subequal, rather thick, joints, the last bearing several longish hairs. Feet normal; tibia shorter than the tarsus; all the digitules are fine hairs. Anogenital ring simple, with eight hairs. On the edge of the body a row of short, strong, conical spines.

Female of second stage usually red, sometimes green or yellow; elliptical, convex above; general form normal of the genus, segmented; length about $\frac{1}{45}$in.; there is a slight white meal on the surface. Anal tubercles conspicuous, setiferous. Cephalic segment rather large. Antennæ of six subequal joints, the last bearing some hairs. Feet rather thick. Mentum dimerous. On the edge of the body a number of strong conical spines, from which spring very short curly tubes.

Larva yellow, flattish, elliptical, segmented; length about $\frac{1}{80}$in. Anal tubercles not very conspicuous, setiferous. Cephalic segment large. Antennæ proportionately long, with six subequal joints, the last hairy. Feet also long; femur rather slender. On the edge a number of strong conical spines, which give to the margin a toothed appearance.

Male unknown.*

Hab. In New Zealand, on *Podocarpus totara*, and sometimes on *Fagus menziesii*, near Reefton.

* Since this paper was written I have found the male of *R. totaræ*. The sac is snowy-white, of very loose texture. The description will be given in a future paper.

The size of the cephalic segment in this insect is peculiar. Had there been any sign of a sac in the adult I should have placed the species in the genus *Eriococcus*, near *E. hoheriæ*, mihi, which also has a very large cephalic segment; but the adult exhibits no cottony sac. The variable antennæ are abnormal. Signoret's original genus *Rhizococcus* was formed to include *R. gnidii*, a European insect having antennæ of seven joints: I have added *R. celmisiæ* (1883) and *R. fossor* (1883), with antennæ of six joints; and I now include *R. totaræ*, where the joints are often five, for in all other respects—form, tubercles, anogenital ring, absence of sac, &c.—it agrees perfectly with *Rhizococcus*.

Rhizococcus pulchellus, sp. nov. Plate VII., figs. 1–5.

Adult female green, or sometimes dull-red or yellowish in colour; general form elliptical; length about $\frac{1}{15}$in. as a rule, but some specimens $\frac{1}{12}$in.; segmented, the segments not very distinct; body longitudinally corrugated with four shallow depressions; covered with many conical spines, from which spring on the dorsum short glassy cylindrical tubes, giving it a numerously-bristled appearance, and on the edges much longer tubes which form a fringe. Antennæ of seven subequal joints. Feet normal of the genus. Anal tubercles small, setiferous; anogenital ring with eight hairs.

Female of second stage bright-green in colour, longitudinally corrugated as the adult, the elevated portions of a lighter green than the depressions; elliptical, flattish, segmented; length about $\frac{1}{15}$in. The ventral surface is convex, the insect forming a shallow depression in the leaf it lives on. All the segments bear very numerous, large, conical spines, from which spring dorsal and marginal glassy white tubes, longer than those of the adult, so that the insect appears studded with silvery spikes and with a long fringe; the marginal spines are a good deal larger than the dorsal ones. Antennæ of six joints, the fourth and fifth rather shorter than the rest. Feet rather large; on the trochanter a long seta; digitules slender, but the lower pair rather more dilated at the end than the upper. Mentum dimerous; there appear to be four rostral setæ. Anal tubercles rather large, setiferous, with a strong spine near the end.

Larva elliptical; colour green with brownish patches; length about $\frac{1}{30}$in.; dorsum flat, slightly corrugated longitudinally; ventral region convex. Antennæ of six joints. Segments bearing spines, but less numerously than in the later stages; the spines are arranged in eight longitudinal rows (including the two marginal series), and bear glassy tubes. On the last four abdominal segments there are also rows of fine small spiny hairs—dorsally, two in the middle of each

segment; ventrally, six on each segment. Anal tubercles normal.

Male unknown.

Hab. In New Zealand, on various species of *Fagus*—*F. fusca*, *F. menziesii*, *F. cliffortioides*, Rimutaka Hills near Wellington, Capleston, Reefton, and Picton; almost always on the leaves.

This is an extremely pretty insect, especially in the second stage, when the bright-green of the body contrasted with the silver fringe and dorsal tubes makes it a very attractive microscopic object. It is not likely to be mistaken for any other species. Unfortunately the bright colours fade after death, and specimens in the cabinet lose much of their natural beauty.

Rhizococcus maculatus, sp. nov. Plate VII., figs. 6–12.

Adult female sub-globular; colour green or brown; length about $\frac{1}{16}$in.; segmented, but the segments indistinct; naked. Anal tubercles rather large, setiferous. Antennæ of six rather thick subequal joints, the last with some shortish hairs. Feet rather thick; tibia shorter than the tarsus; upper digitules fine knobbed hairs, lower pair rather long and largely dilated at the ends; on the trochanter a long seta. Mentum dimerous. Anogenital ring simple, with eight hairs. No spines on the dorsum, but some slender conical spines on the edges.

Female of second stage very light green, spotted on the dorsum sparsely and irregularly with largish patches of intense black; convex, elliptical, ventral region slightly concave; length about $\frac{1}{20}$in.; quite smooth and shiny, the segments very obscure. Anal tubercles very small, and not visible in dorsal view, being hidden by the convexity of the abdomen. The margins bear several conical spines, not set very closely together, from which spring longish, slender, glassy tubes. On the dorsum there are four longitudinal rows of slender spines, two median and two others halfway to the edges. Antennæ of six subequal joints. Feet normal; lower digitules short.

Larva yellow or light-green; flattish; elliptical; segmented, with obscure segments; length about $\frac{1}{70}$in. Anal tubercles conspicuous, setiferous. Antennæ hyaline, with five subequal joints, the last bearing several long hairs. Feet hyaline, rather thick; lower digitules very short. Mentum dimerous. On the margin is a row of conical spines; and on the dorsum are twenty conical spines, larger than the marginal ones and arranged as follows: two pairs at the cephalic extremity, four in a row just above the rostrum, and twelve in four rows on the anterior abdominal segments.

Male unknown.

Hab. In New Zealand, on *Fagus cliffortioides*, Reefton district.

The peculiar appearance of the second stage in this species, its bright-green colour with black spots, and its smooth skin, render it easily recognisable. The arrangement of the spines, &c., is of course not to be clearly made out until the insect has been treated with caustic potash or some other reagent.

Genus ERIOCOCCUS, Targioni-Tozzetti.

I adhere to the plan by which this genus is separated from *Rhizococcus* by the construction of a cottony sac. It will be seen presently that, until further inquiry, I leave also separate the genus *Gossyparia*, in which the distinction has been made to depend only on the quantity of cotton excreted. Such a distinction will not, perhaps, be always retainable, as observation of Coccids in many countries extends; but the genus *Eriococcus* will, I think, be permanent.

Eriococcus raithbyi, sp. nov. Plate IX., figs. 1–18.

Sac of adult female orange-yellow, rather lighter-coloured at the extreme abdominal end; elliptical; convex; very closely felted, smooth and solid in appearance; length averaging about $\frac{1}{16}$in.

Sac of male pupa orange-yellow, lighter-coloured at the abdominal end; cylindrical, slightly convex, narrow; closely felted, like that of the female; length about $\frac{1}{14}$in.

Adult female dark-yellow or red, becoming darker after gestation; at first almost filling the sac, afterwards gradually shrivelling as she becomes void of eggs. Before gestation elongated, ovate, segmented, convex; anal tubercles small but distinct, setiferous; anogenital ring with eight hairs; at the base of each tubercle are three or four spines, and another spine near the tip. Antennæ of seven subequal joints, the third and seventh being a little the longest; a few hairs on each joint. Feet with rather thick femur; on the trochanter a long seta; tibia and tarsus slender, tibia shorter than the tarsus; digitules four, strong hairs with largely-dilated ends. Mentum dimerous (?). On the dorsum a number of small spinnerets—some simple circular orifices, others very minute spiny hairs. On the edges of the segments some very small fine hairs.

Female of second stage yellow, elliptical, convex, segmented; anal tubercles conspicuous, setiferous. Antennæ of six joints the third and sixth a good deal longer than the others. Feet rather short and slender. On the edges many spiny hairs, stronger than those of the adult. There is a thin white meal on the body.

Larva orange-yellow; elliptical; flattish; segmented;

length about $\frac{1}{80}$in. Antennæ of six subequal joints, the last bearing three or four long hairs. Mentum dimerous. Dorsum covered with a great number of small fine spines, and at the edges two rows of strong conical spines. Anal tubercles conspicuous, setiferous.

Adult male orange-yellow, the thorax darker than the abdomen. Abdomen slender, ending in a short genital spike, with the usual curved appendage of the genus; last segment bearing two longish setæ, from which spring very long white cottony "tails." Eyes four, two dorsal and two ventral; ocelli two. Haltere long and slender, with one long seta. Antennæ of ten joints—the first very short; second twice as long and rather thick, dilated at the end; third to eighth slender, the third very long, the rest gradually decreasing; ninth very thick, short and round; tenth also thick, but rather longer than the ninth: all the joints bear numerous hairs. Feet normal; digitules fine knobbed hairs.

Hab. On *Fagus menziesii* in New Zealand. I have pleasure in attaching to this species the name of Mr. Raithby, who has furnished me with many specimens.

This, in every respect but one, possesses the characters of the genus *Eriococcus*. The seven-jointed antenna of the female is abnormal, but I am not inclined to remove it from the genus on that account alone. In the group *Dactylopidæ*, as the insects composing it do not exhibit conspicuous anal tubercles, and excrete only thin cotton or meal, it is necessary to lay stress upon some character such as the joints of the antennæ. But in the *Acanthococcidæ* the presence or absence of a sac is sufficiently distinctive; and as in the genus *Rhizococcus* I have placed *R. totaræ*, with often only five joints in the antennæ, so now I see no valid reason for excluding this new insect from *Eriococcus*, although the normal number of joints in that genus is six. As to its specific position, the character just mentioned, and also the form of the male antenna, serve to separate it from others of the genus. The female sac may be distinguished from that of *E. multispinus* by its smoothness and close texture; the male sac differs also from that species in colour as well as in the closeness of its felting. A further character, separating it from *E. multispinus* and also from *E. pallidus*, is the absence of large conical spines on the dorsum of the adult.

Genus Gossyparia, Signoret.

Adult females not entirely covered by a sac, but excreting a cottony mass, which is thickest beneath them, and either very thin or absent altogether over the dorsum; anal tubercles conspicuous; feet and antennæ retained.

The distinction made by Signoret between this genus and

Eriococcus depends simply upon the quantity of cotton excreted. In *Eriococcus* this is sufficient to form a complete envelope, and the female insect is not visible until the cottony mass has been torn away from it; in *Gossyparia* a certain portion, or the whole, of the dorsal region is exposed. I confess that it seems to me likely that these two genera will have to be, some day, united. The distinction hitherto relied upon does not in any case seem altogether satisfactory. Between *Eriococcus* and *Nidularia*, Sign. (a genus closely resembling *Gossyparia* in outward appearance), there is, besides the difference in the cottony mass, an entirely organic distinction, for *Nidularia* loses its feet and antennæ. Between *Eriococcus* and *Rhizococcus* there is the distinction that the latter constructs no cottony mass at all. These are sufficient characters for separation. But between *Eriococcus* and *Gossyparia* it is only a question of quantity. And as observation is extended numerous links are sure to be found in which the quantity of cotton will be extremely various. The insect about to be described seems to be one of these links. It is not entirely enclosed, like *Eriococcus raithbyi;* it is not quite bare on the dorsum, like the European *Gossyparia ulmi.* I shall leave it in the genus *Gossyparia,* because it certainly has not always what one could call a regular "sac;" but some day the whole genus will probably have to be merged in *Eriococcus.*

Gossyparia cavellii, sp. nov. Plate VII., figs. 13–22.

Adult female stationary, dark-purple in colour, semi-globular, averaging about ⅛in. in diameter; resting on a cushion of yellowish or greyish cotton, with filaments of the same more or less sparsely covering the dorsum; sometimes the body of the insect is quite clearly visible through the threads, at others it is scarcely to be seen. When crushed, the insect stains the fingers a rich-crimson colour. Body segmented, but the segments are indistinct when at full age. Antennæ of six subequal joints. Feet very short; coxa and femur thick, with a somewhat large trochanter on which there is one rather long seta; tibia shorter than the tarsus; all the four digitules are knobbed hairs. Anal tubercles moderate, each bearing at the end two rather short setæ, and with a spine at the base. Anogenital ring with eight hairs. Spiracles circular, funnel-shaped. Very numerous short conical spiny spinnerets on each dorsal segment, most numerous near the edges; interspersed with these are simple circular orifices, which are sparse on the median dorsal region. Mentum dimerous, bearing a few short hairs at the tip.

Female of second stage active, naked; dark-crimson in colour just before the metamorphosis, but red with yellow edges at the beginning of this stage; at first elliptical, but at

last subcircular; convex, distinctly segmented; length about $\frac{1}{30}$in. Antennæ of six subequal joints. Feet as in the adult, but the knobs of the digitules are larger. Anal tubercles conspicuous, with a short pencil of setæ between them. A row of very strong spines runs round the edge, and on the dorsum there are four other longitudinal rows—two close together down the median region, the two others half-way to the edges; the marginal spines often bear glassy tubes.

Larva active, naked; at first yellow or orange, and later a deep crimson-red; elliptical, slightly convex; length about $\frac{1}{80}$in. Antennæ of five subequal joints, rather thick; the last joint bears several long hairs. Feet rather thick. Rows of spines large and conspicuous, arranged as in the second stage.

Male pupa enclosed in a cylindrical, loosely-felted, cottony sac, which is open at the posterior end. Length of the sac about $\frac{1}{16}$in. Colour of sac pure-white.

Male orange-yellow, the thorax darker than the abdomen. Length about $\frac{1}{25}$in., with the usual pair of very long white cottony "tails" from the last abdominal segment. Antennæ of ten joints, each shortening from the head to the tip. Abdominal spike presenting the usual curved appendage noticeable in *Acanthococcidæ*.

Hab. In New Zealand, on *Fagus menziesii*, Rimutaka Mountains, near Wellington, and Capleston, near Reefton. The adults and the females at the close of the second stage affect the axils of the twigs. The larvæ and females of the early second stage, as also the male sacs, are found principally on the leaves. The adult, partly covered with its cotton, is usually inconspicuous, and not easy to find.

The absence of anything like a sac, such as that usually presented by *Eriococcus*, distinguishes this species from any yet described in this country; and it is not at all like any foreign species. The second stage may be easily mistaken for *Rhizococcus*. The male presents no special features; but its sac may be distinguished from those of *E. multispinus*, *E. raithbyi*, &c., by its purely-white colour, and from *Solenophora fagi* by its loose open texture. The rich-crimson colour of the female when crushed is very fine. I have pleasure in attaching to this species the name of Mr. Cavell, of Inangahua, who has been assiduous in collecting and studying Homoptera in that district.

The various kinds of *Fagus* trees have, as this paper shows, furnished me so far with six species of Coccids, all of which will, I believe, stand the test of careful scrutiny as distinct species. Two of them—*Solenophora fagi* and *Dactylopius obtectus*—are of somewhat special interest, and the others are in their way also curious. I believe that there is also a Lecanid

peculiar to *Fagus;* at least, I have taken, at Picton, a blue *Lecanium* on *F. cliffortioides* which seems entirely new; but, having never seen more than one specimen, I refrain from attempting to classify it.

Subdivision DACTYLOPIDÆ.

Genus DACTYLOPIUS, Costa.

Dactylopius cocotis, sp. nov. Plate IV., figs. 16–24.

Adult female red, covered with much cottony secretion; broadly elliptical; convex; segmented, the segments conspicuous; active; length about $\frac{1}{7}$in. Anal tubercles not visible in dorsal view, but they can be made out ventrally. They are very small, and each bears a few short setæ. Anogenital ring compound, with six hairs. On each segment of the body are several short fine hairs, appearing at the edges like little tufts. Antennæ of eight joints—the second the longest; fourth, fifth, sixth, and seventh the shortest, and equal: all the joints bear a few hairs. Feet with rather thick femur; upper digitules long fine knobbed hairs, lower pair very short fine hairs; femur, tibia, and tarsus hairy; and on the trochanter is one long seta. Mentum dimerous.

Second stage of female similar to the adult, but a good deal smaller, and with antennæ of seven joints.

Larva red, elongated, elliptical, distinctly segmented, active; length about $\frac{1}{25}$in. Cephalic extremity distinctly depressed. Antennæ rather thick, with six subequal joints. Feet and digitules as in adult. The anal tubercles are very small and inconspicuous, each bearing a seta. At the edge of each segment are three or four hairs.

Male unknown.

Hab. In Fiji, on *Cocos nucifera* (cocoanut). Mr. Holmes tells me that it lives "on base of fronds while white and not fully developed."

This insect seems intermediate between the two New Zealand species *D. calceolariæ* and *D. alpinus*. It is smaller, and has a greater quantity of cottony and mealy secretion than the former, and it has not the rich-red tint of the latter when crushed. In the antennæ and digitules, and absence of spinneret tubes or other appendages, it likewise differs from both.

Dactylopius calceolariæ, mihi, "Scale-Ins. of N.Z.," p. 100.

On some pieces of sugar-cane sent to me by Mr. Holmes from Fiji were several insects which I cannot distinguish from *D. calceolariæ*. They affect, apparently, chiefly the "sheathing base" of the leaves, in the same way as in New Zealand they are found in a similar position on *Phormium tenax*. Some

small caterpillars (lepidopterous?) were amongst the specimens, and Mr. Holmes says that they seem to "eat the Coccids."

Dactylopius arecæ, sp. nov. Plate VIII., figs. 1–6.

Adult female yellowish-brown, sometimes reddish, covered with a brownish-yellow coating of meal, which is not, as usual, cottony, but granular and loosely attached; elliptical; convex; segmented; abdominal extremity rather truncate; length about $\frac{1}{11}$in. On the segments are many small fine hairs. Anal tubercles very inconspicuous, each bearing four or five longish hairs. Anogenital ring compound, with six hairs. Antennæ of eight joints—the last the longest, the first and second very short. Feet slender; all the joints hairy; on the trochanter a long seta; upper and lower digitules fine hairs; tibia slightly dilated at the tip, and bearing there a short stiff spur. Mentum dimerous, with several spiny hairs at the tip. On the segments of the body are a large number of circular simple spinneret-orifices.

Second stage of female similar to the adult, but smaller, with antennæ of seven joints, and a tibia shorter than the tarsus.

Larva and male unknown.

Hab. In New Zealand, underground, on roots of *Areca sapida* (nikau palm); as yet only from Wellington. It differs from the other New Zealand subterranean species, *D. poæ*, in the granular character of the mealy secretion, and in the spur of the tibia.

Dactylopius adonidum, Linn.

This species, not hitherto reported from New Zealand, occurs here in the hothouses and stoves of Government House, Wellington. At least, the characters belonging to it appear to be so close to those of the common European "mealy-bug" that I do not attempt to separate it. There are several species in Europe so nearly resembling *D. adonidum* that it is extremely difficult to identify them—*e.g.*, *D. citri*, Boisduval, *D. cyperi* or *D. pteridis*, Signoret, &c. All of them differ from the New Zealand species *D. glaucus* and *D. calceolariæ* (besides their colour and size) in the presence of conspicuous marginal filaments.

Dactylopius poæ, mihi, "Scale Ins. of N.Z.," p. 101.

In its natural state, on roots of tussock-grass, underground, this insect excretes only a thin white mealy cotton, visible in small patches about the roots. But, having collected this winter some thirty or forty specimens, and placed them in a glass tube, I was surprised to find that they filled the tube

with abundant cotton. I turned them out into a deep watch-glass and brushed the cotton away. After a few days they surrounded themselves with another thick mass, in which they are now entirely hidden.

Dactylopius aurilanatus, sp. nov. Plate VIII., figs. 7–18.

Adult female slightly elongated, nearly globular; of a rich dark-purple colour, bearing on the dorsum a longitudinal band of bright golden-coloured meal, with small patches of similar meal often visible at the edges. In alcohol or potash it produces a rich-purple tint, and if crushed in the fingers stains them dark-red. The eggs, which are also purple, are laid in a mass behind the insect, in a thin white cottony web, the mass having thus a general dark-grey appearance. Body obscurely segmented. Length about $\frac{1}{11}$in. Antennæ usually of eight joints, often of seven; in the former case the fourth, in the latter the third, joint is the longest, the rest subequal, except the last, which is fusiform, and nearly equal to the longest: all the joints have a few hairs, the last bearing several. Feet normal, not very slender; upper digitules long fine knobbed hairs, lower pair slender with dilated ends. Anal tubercles very inconspicuous, each bearing one long seta and a few very short hairs. Anogenital ring compound, with six hairs. Spinnerets not numerous, chiefly situated on the median dorsal region; mostly simple circular orifices, with some short fine spiny tubes amongst them. On the cephalic region are a few short hairs.

Female of second stage rich-purple in colour, bearing longitudinal rows of golden-coloured meal in detached patches: at the commencement of this stage, however, the meal is nearly white. The rows are arranged as follows: one along the middle of the dorsum, one along each edge, and two others intermediate; five in all. The meal is in detached lumps or masses, which permit the purple body to be seen between them, giving a tessellated appearance to the insect. Body obscurely segmented; convex above; outline elliptical; length about $\frac{1}{24}$in. Anal tubercles inconspicuous, each bearing a seta, the meal on which protrudes farther than in the other patches; between them the hairs of the anogenital ring are usually coagulated in a pencil of white cotton. Anogenital ring with six hairs. Antennæ of seven joints, all hairy, the last bearing several hairs and two short terminal spines. Feet as in the adult. Spinnerets fairly numerous, all of them simple circular orifices.

Larva dull-purple, covered with thin white meal; flattish; elliptical; very active; length about $\frac{1}{50}$in. Mentum rather large, dimerous. Anal tubercles conspicuous. Antennæ of six joints, the last fusiform, a good deal the longest, and bear-

ing two short terminal spines. Feet and digitules as in the adult, but the tibia is shorter than the tarsus.

Male pupæ inhabiting white cottony masses, very small, intermingled with the meal and egg-masses of the females; they do not seem to form regular sacs.

Adult male brown in colour, covered with thin whitish meal; length about $\frac{1}{20}$in.; general form normal of the genus, with slender thorax and abdomen and short spike; from the last abdominal segment spring two not very long setæ, bearing cotton, and forming the usual "tails." Antennæ with ten rather thick joints, all subequal in length, the second being a good deal thicker than the rest; all the joints bear several short hairs. Feet slender, hairy; digitules fine hairs. Eyes four, two dorsal, two ventral; no dorsal ocelli, but at each side there is one, on the edge.

Hab. In New Zealand, on *Araucaria bidwillii*, at Auckland, and spreading from that to *Araucaria excelsa* and other adjacent conifers. My specimens are from the garden of the late Mr. Justice Gillies, where the insect has been plentiful. It cannot be looked on as indigenous to New Zealand: in all probability it is an importation from Australia; Queensland may be perhaps the original locality.

If left undisturbed, *D. aurilanatus* seems to smother the plant with its numbers of adults, pupæ, and egg-masses, and soon renders it unsightly. In a warm climate, I fancy, it would spread rapidly, as the eggs are very numerous and the larvæ very active.

The appearance of this insect is peculiar, and in a specimen cleared from cotton not without beauty, from the dark-purple of the body contrasted with the bright-golden colour of the excreted meal, and the mode of arrangement of the latter; and I think it cannot be confounded with any other species of the genus. The fact that individual females may be found with either seven or eight joints in the antennæ is abnormal; but a similar discrepancy is reported in *Dactylopius bromeliæ*, Bouché (Signoret, "Essai," p. 344), a South American species.

Dactylopius obtectus sp. nov. Plate VI., figs. 12–21.

Adult female sheltering itself beneath a leaf- or bud-scale of the food-plant; excreting in this position much white cotton, in which the eggs are laid. Colour red; body elliptical, convex, segmented, shrivelling after gestation; length about $\frac{1}{30}$in.; the last segment of the abdomen is slightly produced cylindrically, with inconspicuous setiferous anal tubercles. Mentum dimerous, with several short hairs at the tip. Antennæ of eight joints, subequal except the last, which is irregularly fusiform and longer than any two others. Anogenital ring compound, with six hairs. Spinnerets scattered all over the body

—some simple circular orifices, others small cylindrical tubes.

Female of second stage and larva unknown.

Male unknown.

Hab. In New Zealand, on *Fagus fusca* (black-birch), near Reefton; apparently only on the twigs.

The employment of a bud-scale as a covering by this insect in the adult state is peculiar, and abnormal in the genus. The *Dactylopii* are as a rule either active and almost naked even during gestation, or simply surround themselves with cottony secretion. The scales of *Fagus fusca* are very small, red in colour, and triangular, and their concavity on one side forms a most convenient shelter for this insect, which is only to be detected from the small fringe of cotton which usually protrudes from beneath the edges of the scale—in fact, it would be scarcely noticed in most cases. The prolongation of the abdomen is a character which distinguishes *D. obtectus*, apart from its mode of concealment, from other species of the genus. I am indebted to Mr. Cavell for this species.

Subdivision MONOPHLEBIDÆ.

Genus CŒLOSTOMA, Maskell.

Cœlostoma assimile, sp. nov. Plate IX., figs. 19–24.

Female of the second stage covered by a hard waxy test of irregular shape. Insect globular, reddish, smooth, very obscurely segmented; diameter about $\frac{1}{20}$in. in the specimens observed; filling the test. Antennæ thick, conical, very short, with four joints. Feet absent. Rostrum and mentum very large; mentum long, sharply conical, trimerous. Skin covered with a great number of circular spinneret-orifices of two sizes, all simple. Tracheæ very large, ending in sixteen vasiform spiracles. At the abdominal extremity a large brown patch, in which is the anogenital simple ring; and there is a large internal tubular (honey-dew ?) organ, with a group of circular glands at its interior end, and a ring of similar glands halfway along it.

Adult female, larva, and male not observed.

Hab. In New Zealand, on *Fagus* sp., Reefton district.

Although I have only the second stage of this insect, it resembles in so many particulars *C. zealandicum*, mihi, that I have no hesitation in fixing its generic position. In size it is much smaller than the average of that species; at the same time, I have seen on the same twig waxy tests of *C. zealandicum*, varying from the size of a large pea down to that of a large pin's head; and possibly those of *C. assimile* may also vary considerably. This insect is quite distinct, in the absence of the feet, in the four-jointed antennæ, and in the very large

rostrum and mentum of the second stage. All the tests which I have seen are in the axils of the twigs of *Fagus*. Probably the adult female, when discovered, will prove to be a dark-red, naked, wandering insect, of much the same form as *C. zealandicum*. I have on one occasion seen a specimen from the forests of Otago (since lost) which had several large papillæ on the dorsal segments, and was otherwise similar to, though smaller than, *C. zealandicum*: this might perhaps be the adult form of *C. assimile*.

The foregoing paper includes all the species of Coccids which I am at present able to describe. I have, in addition, in my collection some insects from South Australia—a *Dactylopius*, a *Kermes*, two or three *Eriococci*, &c., and a most extraordinary Coccid of gigantic size (nearly an inch long and half an inch high); but these are, as to their descriptions, the property of my friend Mr. F. S. Crawford, of Adelaide, who tells me that he proposes to publish them some day. I hope that he will be able to do so before long.

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[NOTE.—With the exception of Plate IX., fig. 1, all the figures in these plates are much enlarged.]

ART. XVII.—*On some Species of* Psyllidæ *in New Zealand*.

By W. M. MASKELL, F.R.M.S., Corr. Mem., Royal Society of South Australia.

[*Read before the Wellington Philosophical Society, 2nd October, 1889.*]

Plates X.–XII.

THE *Psyllidæ* are a family of insects, of the order *Homoptera*, more nearly allied to the *Aphididæ* than to *Coccididæ*, though in many cases, where they are fixed and stationary in their earlier stages, they exhibit much of the appearance of the latter family—so much so, indeed, that sometimes close examination only can detect the difference. They seem to be cosmopolitan, but up to the present the European species have been chiefly studied. From New Zealand, so far, no species have been reported, but at least four or five appear to exist here. Several entomologists in Europe have studied this family since the time of Linnæus and Réaumur: the principal modern authorities are Dr. F. Löw, in Germany, and Mr. J. Scott, in England.

The *Psyllidæ* are, in the adult state of both sexes, pretty little four-winged flies, variously coloured. They are very well adapted for leaping, whence they have derived their Greek name, and also their trivial name of "leaf-hoppers." In their earlier states they often exhibit colours and forms of singular beauty. They live altogether on various plants, extracting from these their food by means of a rostrum and setæ, as do the Aphides and Coccids.

The *Psyllidæ* belong to the dimerous subdivision of the *Homoptera*—that is, insects with two-jointed tarsi. They may be further distinguished from Coccids by the presence of four wings and a double claw in both adult sexes. The different subdivisions of Psyllids are separated by systematists on characters which are very minute and often difficult of detection. Colour is to some extent taken into account, although for my part I would lay very little stress upon this (and the remark may extend to other orders of insects besides *Homoptera*); for not only are there several variations in the insects themselves, but I doubt whether any two men agree exactly in the nomenclature and appreciation of colour: shades of green and blue, of red and purple or violet, and so on, might lead (and I think have led) entomologists into much diffuseness of description and useless multiplication of species. There are, however, several minute differences noticeable amongst *Psyllidæ* which are of greater value, and from the principal amongst these the sub-families may be separated as follows:—

Sub-family *Liviinæ*, F. Löw: Front of head not prolonged into conical processes; eyes not prominent; the stalk of the lower branch (cubitus) of the furcation of the primary vein in the forewing much longer than the stalk of the upper branch (subcosta).

Sub-family *Aphalarinæ*, F. Löw: Front of head either swollen, or prolonged into two conical processes, or roughly ragged; eyes prominent; stalk of the cubitus in forewing as long as, or longer than, the stalk of the subcosta in almost all cases.

Sub-family *Psyllinæ*, F. Löw: Front of head either swollen or produced into two conical processes; eyes prominent; stalk of the cubitus in forewing shorter than the stalk of the subcosta.

Sub-family *Triozinæ*, F. Löw: Front of head either swollen or produced into two conical processes; eyes more or less prominent; stalk of the cubitus in forewing wanting (the vein forking directly from the junction with the subcosta).

Sub-family *Prionocnemidæ*, Scott: Front produced into conical processes; eyes prominent; stalk of the cubitus in forewing very short; tibiæ slightly serrated. (Are these sufficient distinctions?)

It will be seen that the first principal character for differentiation here is a point in the venation of the forewing. As this point cannot well be made clear by any written description, I give diagrams (Pl. X., figs. 1, 2) of a wing of *Psylla* and one of *Trioza*, in which *bd* is the stalk of the subcosta, and *bc* (which exists only in the former) the stalk of the cubitus. In fig. 4, belonging to the sub-family *Aphalarinæ*, it will be seen that *bc* is a good deal longer than *bd;* in fig. 1 it is shorter; in fig. 2 it is altogether wanting.

There is a further feature in *Psyllidæ* which is common to all the sub-families, but of which the variations may be employed for generic and specific differentiation—it is the character of the genital apparatus in either sex. That of the adult female has always the form of more or less sharp-pointed valves produced in a direct line with the abdomen, and within these is the ovipositor. That of the adult male consists of a number of appendages erect on the last segment of the abdomen, and having between them the penis; these appendages are on the dorsal side, and it is not clear what may be their use. The anterior one is usually the largest, sometimes as if with two broad wings or with two lateral slender processes: this is called the "genital plate;" and on the variations of this and the posterior appendages it is possible to separate species and even genera. The difference between the genitalia of the male and the female is very easily

made out, so that an observer has no difficulty in knowing the sex of the insect under examination.

I have found no notice in published descriptions of a feature which is especially noticeable in the larval and pupal stages of *Psyllidæ;* yet I am not sure that this may not be at least a character to be employed for differentiation of species. I mean a distinctly-marked ring which surrounds the anal orifice. This is situated close to the abdominal extremity, and the ring is of an elongated form, its edge somewhat wide and having the appearance of being closely corrugated, or perhaps formed of a series of small elongated pores set close together. The ring seems to represent what in Coccids is termed the anogenital ring. It is present in the adult, but less conspicuously than in the larva and pupa; and in these two earlier stages it is always transverse, while in the adult (at least, frequently) it is longitudinally placed above the genitalia. I find that in all the species observed by me in New Zealand the form of this ring varies, as shown in the accompanying figures; and I incline to the belief that it may perhaps be more usefully employed for specific differentiation, at least, than, say, colour or size, or even the food-plant.

Order HOMOPTERA.

Family PSYLLIDÆ.

Sub-family APHALARINÆ, F. Löw.

Genus RHINOCOLA, Forster.

Front of head prolonged into two conical processes; eyes prominent; forewing with a long stigma (Pl. X., fig. 4, *ss*); stalk of the cubitus longer than that of the subcosta; radius quite or almost straight; genital plate of the male not produced posteriorly into slender processes.

The distinctions between this and the kindred genera *Aphalara*, Forster, and *Psyllopsis*, Löw, depend upon very minute characters. In *Aphalara* the radial vein (fig. 4, *df*) is usually much curved, and the genital plate of the male is prolonged into two slender processes which encircle the penis as in a loop. In *Psyllopsis* the genitalia of the male are more like those of *Rhinocola*, but the stalk of the cubitus is only as long as that of the subcosta. *Rhinocola*, in fact, holds an intermediate position; but it would seem that some day the extreme minuteness and delicacy of the characters now relied on for differentiating genera and species of *Psyllidæ* must bring about a simplification of the system. The progress of observation in many new countries will probably make known individuals combining so many features now considered important that the present classification cannot be kept up.

Rhinocola eucalypti, sp. nov. Plate X., figs. 3–16.

Adult female of a general dark-purple colour, almost black; length of body about $\frac{1}{16}$in. When viewed dorsally, the head and thorax are dark-purple, the wing-attachments yellow; there is a very thin whitish meal on the thorax; abdomen dark-purple, banded transversely with yellow; antennæ yellow, turning to black at the tips; genitalia black; eyes dark-brown, prominent; wings membranaceous, greyish-white, veins yellow. Viewed ventrally, the head and thorax are purple, with yellow stripes; legs dark-yellow. Head broader than long, rather deeply depressed in front, and prolonged into two short, roundly conical processes. Ocelli two, close to the eyes. Rostrum short, cylindrical, and bearing three moderately long setæ. Forewings elongate, length about two and a half times the breadth. Margins somewhat straight and parallel, ends broadly rounded; the veins are almost all nearly straight. The costal vein runs all round the margin; the stalk of the cubitus (fig. 4, *bc*) is almost twice as long as the stalk of the subcosta (fig. 4, *bd*); the cubitus forks twice, the second furcation being close to the apex of the wing, the lower main branch forking again near the middle of the margin, with one long and one short secondary branch; the subcosta also forks twice, the main branch (the radius, fig. 4, *df*) being straight and nearly parallel to the cubitus, the other branch forking very close to the margin with one very short reflex branch, and one very long, which meets the costa at a point as far from the radius as the latter is from the cubitus; the whole area enclosed between the costa and the two secondary branches of the subcosta is occupied by the stigma (fig. 4, *ss*), which is thus very long and narrow, but not very distinctly marked. Hindwings elongate, broadly rounded at the tips, with three longitudinal veins not clearly reaching the margin, and only the posterior one is forked. Antennæ of ten joints—the first two rather short, thick, and smooth, the rest very slender, and numerously ringed; the third joint is the longest, the sixth and eighth subequal and nearly two-thirds as long as the third, the rest rather shorter and subequal; the last joint is slightly dilated, and bears two unequal spines at the tip. Legs moderately slender; tarsi dimerous; claw double; several short hairs on all the joints. Genitalia bivalve, somewhat sharply pointed; the lower valve is as long as the abdomen, the upper a very little shorter; several short hairs on both valves.

Adult male very similar to the female, excepting in the genitalia, which consist of several appendages carried erect, dorsally, on the last segment of the abdomen. The figure 8 of Plate X. gives a clearer idea of these appendages than any written description could do: *a* is the "genital plate," which

is very slightly swollen in the middle, but does not bear any lateral processes; *b* are two terminal processes set close together; *c* is the penis. All these appendages bear several short hairs.

Pupæ active, gregarious, naked, except for a slight mealy covering, and for the loose cottony threads in which they move; length about $\frac{1}{20}$in. Viewed dorsally, the head is dark-purple, almost black, with a narrow median longitudinal stripe of yellow; thorax yellow, with dark-purple rectangular patches on each side; abdomen in the anterior half yellow with two narrow transverse purple stripes interrupted in the middle, and in the whole of the posterior half dark-purple; rudimentary wing-covers dark-purple; antennæ yellow, darkening nearly to black at the tips. Viewed ventrally, the head and thorax are yellow, the abdomen yellow with rectangular purple patches; legs dark-yellow. Eyes dark-brown, scarcely at all prominent. Head broadly rounded in front, without conical processes. Antennæ of nine joints, the first two short and thick, the third and seventh the longest; the last three joints are ringed, and the last bears a short spine. Legs thick and clumsy; claw double. Rostrum short. Rudimentary wing-covers attached to the thorax, not extending to the head, and the hinder one only just reaches the second segment of the abdomen. There is no conspicuous fringe round the body, but the abdomen exhibits some lanceolate spines (fig. 13). If the pupa is macerated in potash the purple portions of the epidermis, on the dorsal surface only, are seen to be covered with a number of small oval puncta or orifices; and at the extremity of the abdomen there are a good many larger orifices which are multilocular; all of these markings appear to be "spinnerets" similar to those of Coccids, for from those at the extremity proceed slender cottony threads forming the loose mass in which the pupæ move. At the extremity of the abdomen the elongate transverse ring (fig. 16) is slightly concave on the anterior edge, and rather wide at the ends.

Larvæ active, gregarious, naked in loose masses of thin meal and cottony threads; length about $\frac{1}{36}$in. General colour and arrangement of the darker patches similar to those in the pupæ, but much lighter, the larvæ having thus a generally yellower appearance. Head broadly rounded in front and rather deeply depressed. Antennæ of four joints, the third much the longest, the fourth bearing two unequal spines. Legs thick and fat; tarsus very small and its joints hardly to be made out; there are two rather long tarsal digitules. Several short hairs round the body-margin, and on the abdomen some lanceolate spines. Anal ring as in the pupa, and at the extremity of the abdomen many multilocular orifices, whence issue slender cottony threads.

Hab. On *Eucalyptus globulus,* throughout New Zealand. The insects are found in numerous colonies, adults, pupæ, and larvæ intermingled, on the youngest shoots only of the tree, congregated between the stem and the immature leaflets, the spaces filled with their loose white cotton and meal. They do not seem to do any damage to the tree. The leaves of *E. globulus* in their very young state are quite different from the older ones (which latter, indeed, are not, I believe, strictly speaking, real leaves) — they have a distinct bluish tinge, whence the tree has derived its trivial name of "blue-gum," and they exude a quantity of white aromatic gummy matter, on which apparently *Rhinocola eucalypti* feeds, so that the leaves themselves are not damaged. The insects are not particular about the seasons; all stages may be found at any time of the year in colonies, though in cold weather the winged adults seem sleepy and sluggish.

Eucalyptus globulus is a Tasmanian tree, and Tasmania may therefore be the original home of this *Rhinocola.* I have not found the insect on any other tree in New Zealand, but on *E. globulus* it is very common.

I have attached this insect to the genus *Rhinocola* on account of the straightness of the veins in the forewing (in *Aphalara* they are usually much curved) and the absence of processes from the genital plate of the male. There are some minute differences from the genus, and the genitalia of the male, taken by themselves, might relegate it to the genus *Psylla* (compare *P. viburni,* Löw, or *P. salicicola,* Forster), but the wing-venation fixes it amongst the *Aphalarinæ.*

The late Mr. J. Scott informed me that in the British Museum there are no specimens of *Psyllidæ* from this part of the world, but that in one of the drawers there is "a label relating to a species feeding on the Eucalyptus." I cannot say whether this may refer to our species; but probably it is rather one of the three described by Mr. Dobson ("Proc. of Roy. Soc. of Tasmania," 1850, p. 235). These insects form little waxy conical or scallop-shaped tests on various Eucalypti in Australia, which tests are often aggregated in great masses of "manna," used as food by the aborigines, and very sweet to the taste; indeed, a hungry European explorer lived awhile, on one occasion, on this "lerp," as it was called. The adults of Mr. Dobson's species differ slightly from our *Rhinocola.* In their wax-producing habit they are entirely distinct.

Rhinocola fuchsiæ, sp. nov. Plate XII., figs. 13–25.

Adult female when first emerging from the pupa-case very light yellow, almost white. Later, the head and dorsal surface of the thorax become patched with black, the abdomen remaining yellowish. Eyes brownish-red, ocelli dark-yellow.

Antennæ and feet hyaline. Genitalia yellow, with brown extremities. Length of body $\frac{1}{23}$in.; expanse of wings about $\frac{1}{20}$in. Head broader than long, very slightly depressed in front, and prolonged beneath into two short conical processes. Thorax considerably elevated. Eyes exceptionally prominent projecting at each side nearly half the width of the head, and somewhat recurved posteriorly, the anterior portion with rather large facets, the hinder part smooth. Antennæ of ten joints—the first two short, rather thick, equal and smooth, the rest slender; the third rather longer than the two first together, the others subequal, and about half as long as the third; all except the two first are numerously ringed, and the last bears two unequal spines. Forewings very short, scarcely extending beyond the genitalia; margins slightly and regularly convex, ends rounded; length of wing two-and-a-half times the breadth. All the veins are nearly straight, being very slightly convex towards the costal margin; primary stalk of veins rather short, about one-ninth of the length of the wing; stalk of the cubitus not quite twice as long as the stalk of the subcosta, and only a little longer than the primary stalk; the first furcation of the cubitus forks again close to the dorsal margin, with one short branch and one long; the upper secondary branch of the second furcation reaches the margin a very little below the apex; the clavus is somewhat strong; stigma existing, and filling the area between the margin and the longer secondary branch of the subcosta, but very faint. Wing sparsely punctate. Hindwing rounded, punctate. Feet presenting no special features. Genitalia, viewed dorsally, apparently ending in a single acute point; viewed sideways, after slight pressure, they exhibit four very acute valves, of which two have serratulate margins, and also bear some short hairs.

Adult male similar in general form and colour to the female, but the elytra are rather longer, extending a little beyond the genitalia. Genital plate broadly rounded posteriorly, and tapering to a bluntly-rounded tip with a few short hairs; posterior processes cylindrical, about three-quarters the length of the genital plate, and bearing several strong, longish hairs, and a great number of black, thick, tubercular papillæ, like strong teeth, arranged in three longitudinal rows.

Pupa usually stationary, but capable of motion; whitish and somewhat translucent, the abdomen exhibiting a faint yellow patch; eyes red; wing-cases, antennæ, and feet white. Length about $\frac{1}{18}$in. Head rounded, slightly produced in front; eyes scarcely prominent; ocelli two. Antennæ of eight short, rather thick, subequal joints, the last black, conical, and bearing two unequal spines. Rudimentary wing-covers reaching only to the second segment of the abdomen. Feet normal, with a pulvillus and two tarsal digitules. Abdomen elongate-

ovate, bearing at the extremity some small spines, which bear short white cotton, producing a brush-like appearance. Anal ring with a regularly convex posterior edge, the anterior edge rather deeply depressed on each side of a median projection, and the ends rather angular. Several minute spines on the abdomen and feet.

Hab. In New Zealand, on *Fuchsia excorticata.*

I place this insect in the genus *Rhinocola* because, in the wing-venation (straight veins) and in the form of the male genital plate, it agrees with that genus. The excessive prominence of the eyes in the adult, the quadri-valve female genitalia, and the angular ends of the anal ring are distinguishing characters; and the strong black papillæ on the male genital processes are, as far as my information extends, unique in the family. But I do not take these as anything more than specific distinctions, especially abominating (except on the clearest grounds) the erection of new genera on single species. *R. fuchsiæ* is the smallest of the New Zealand *Psyllidæ* which I have yet seen; and its very delicate colour, both in the adult and in the pupal states, makes it difficult of detection on the white under-surface of the leaves of the tree-fuchsia, its favourite plant.

Sub-family TRIOZINÆ, Löw.

Genus Trioza, Forster.

Front of head produced into two conical processes; stalk of the cubitus in forewing wanting; third joint of the antenna not thicker than the fourth.

The last character here mentioned serves to separate *Trioza* from *Bactericera*, Forster, in which the third joint of the antenna is as thick as the first two. I am not sure that so minute a difference is sufficient for generic distinction. *Bactericera* appears also to have the front of the head only "swollen" anteriorly; but a similar fact is not considered of great importance in the *Aphalarinæ*, and the swelling may be so near to the short conical processes of *Trioza* that perhaps future systematists may unite the two genera.

Trioza pellucida, sp. nov. Plate XI.

Powellia vitreoradiata, mihi, "Trans. N.Z. Inst.," 1878, p. 223.

Adult female of a generally light-brownish colour with green shades, becoming slightly darker with age; length, inclusive of genital valves, about $\frac{1}{14}$in.; expanse of wings $\frac{2}{9}$in. Viewed dorsally the head is yellow, thorax generally yellow (rather darker than the head), prothorax brown; eyes prominent, rich dark-brown; ocelli light-brown; abdomen yellow, with

transverse bands of brown; genitalia dark-brown, almost black; wings hyaline, colourless. Viewed ventrally, the general colour is yellow, with patches of light-brown. Legs yellow; antennæ brown. Head broader than long, depressed in front and produced beneath into two moderately long conical processes. Ocelli two, close to the eyes. Rostrum cylindro-conical, black at the tip; setæ short. Forewings elongate, slightly apiculate; costal margin regularly convex, dorsal margin slightly concave; primary stalk of veins (fig. 2, *ab*) one-fourth the length of the whole wing; stalk of the sub-costa (fig. 2, *bd*) one-third as long as the primary stalk; radius (*df*) convex in its middle part towards the costal margin, and reaching the costal vein at rather more than five-sixths of the length of the wing; cubitus forking directly from the sub-costa, its upper main branch convex and forking a little before reaching the margin; the upper secondary branch joining the costal vein a little above the apex; the lower main branch forking close to the middle of the dorsal margin, with one short and one long and very convex secondary branches; in the areas formed by the branches of the cubitus are three short markings springing from the costal vein and having the appearance of nervelets, but which on close examination are seen to be composed of a number of minute oval spots (fig. 3); on all the veins of the wing are some very short fine hairs; but there are no puncta on the surface. Hindwings with the anterior margin somewhat straight, but a little convex at nearly half its length; posterior margin deeply and regularly convex; ends rounded; a single vein runs along almost half the anterior margin, and there are three other exceedingly fine and delicate longitudinal veins, of which the anterior is slightly concave to the anterior margin, which it joins rather above the apex; the second, also concave, joins the margin below the apex; the third forks near the middle of the posterior margin, with one short and one long branch; the whole hindwing is sparsely but clearly punctate. Antennæ of ten joints—the first two short, thick, and smooth, the rest slender and numerously ringed; the third joint is the longest, the fourth, fifth, sixth, and seventh subequal and nearly half as long as the third; the last three subequal, a little more than half as long as the fourth, the last joint slightly dilated and bearing two unequal spines. Legs slender; tarsi dimerous; claw double; there are a few short spines at the tip of the tibia. Genitalia bivalve; viewed sideways the lower valve is rather longer than the upper; both are rather sharply pointed, and bear several hairs.

Adult male similar to the female, but in most cases much lighter in colour, having a generally yellow appearance. Genitalia consisting of a genital plate (fig. 9, *a*) which has two

broad lateral wings, or lobes, swollen posteriorly; of a posterior appendage (*b*) divided at the end into three recurved hooks; and of a short penis (*c*) a little dilated at the tip. Many short hairs on all the appendages.

Pupa flat, stationary; length about $\frac{1}{18}$in. Viewed dorsally the general colour is yellowish, but from the transparency of the body the green chlorophyll-food may be easily seen; head darker yellow; eyes obscurely facetted, red; rudimentary wing-covers greyish-white; antennæ yellow, darker at the tips; all round the margin is a fringe of long, white, glassy tubes set very close together. Head broader than long, slightly depressed in front. Eyes scarcely prominent. Antennæ of six joints—the first two short, the third equal to the first two together, fourth and fifth short, the sixth almost as long as all the rest together, tapering to a point and bearing at the tip two unequal spines. Rudimentary wing-covers attached to the thorax, but immediately widening anteriorly, so that they have the appearance of being joined also to the head; the hinder one reaches almost to the second segment of the abdomen. Legs thick; the second joint of the tarsus is exceedingly small; on the first joint is one long seta bent at the end; claw double, with a large pulvillus. Abdomen as broad as long, margin semicircular, with a very slight median depression; near the extremity the anal elongated ring is very slightly concave anteriorly, the ends compressed and somewhat acute. Rostrum short, cylindro-conical. The fringe of the body and wing-covers is formed of very delicate, glassy, straight tubes issuing from cup-like bases set close together.

Larva active; length about $\frac{1}{30}$in.; general colour yellow. Viewed dorsally the head exhibits a darkish patch on each side of a median longitudinal yellow stripe; the thorax two patches on each side; the abdomen has four narrow transverse bands and a dark patch covering the posterior half. Antennæ of four joints—the first two short, the fourth about equal to the first two, the third as long as the others together; on the last joint are two unequal spines. Legs thick; second joint of the tarsus extremely small; two moderately long tarsal digitules. On the abdomen are some lanceolate spines. There is no tuft of cottony fibres on the abdomen.

Hab. On *Pittosporum eugenioides*, *Discaria toumatou*, and *Geniostoma ligustrifolium*, throughout New Zealand; probably most frequently on *Pittosporum*.

This very handsome species seems clearly to belong to the genus *Trioza*, but differs in various points from described species. The genital plate of the male bears some resemblance to those of *T. horvathi*, Löw, *T. walkeri*, Löw, and some others; but the posterior process, with its three hooks, seems

distinctive. The pupa is not unlike that of *T. flavipennis*, Forster, but the wing-venation differs from that species.

In 1878, having then no knowledge of *Psyllidæ*, I mistook the pupa of *T. pellucida* for some new kind of Coccid, although I recognised some characters removing it from that family. I now restore it to its proper place.

Trioza panacis, sp. nov. Plate XII., figs. 1–12.

Adult female of a bright, vivid, green colour, the thorax slightly patched with light-yellow; eyes red, ocelli yellow; genitalia tipped with light-brown; femora green, tibiæ and tarsi yellow; antennæ yellow, the last joint and the extreme tips of the others brown; wings hyaline, with the faintest possible brown tinge. Length of body rather less than $\frac{1}{8}$in.; expanse of wings $\frac{2}{7}$in. Head broader than long, depressed in front and produced beneath into two moderate roundly-conical processes. Eyes prominent, minutely facetted; ocelli two. Rostrum cylindro-conical. Forewings elongated, the ends rounded; costal margin regularly convex, dorsal margin very slightly concave as far as the junction with the cubital vein; primary stalk of veins one-fourth the length of the wing; stalk of the subcosta (fig. 3, *bd*) two-fifths of the length of the primary stalk; radius convex at two-thirds of its length towards the costal margin, and reaching the margin at about seven-eighths of the length of the wing; cubitus forking directly from the subcosta, its upper main branch convex towards the costal margin, and forking at rather more than three-fourths the length of the wing, the upper secondary branch joining the margin exactly at the tip, the lower at rather less distance than the radius; the lower main branch of the cubitus forks a little below the middle of the wing, with one longish, very convex branch, and one shorter and nearly straight; the distances between the points of junction of the margin with the radius and with the cubital branches are about equal. In the three areas formed by the cubital branches there are three short triangular marks springing from the margin, and composed of minute oval spots. There are some exceedingly minute spiny hairs on all the veins. Hindwings normal, presenting no special features, but slightly punctate. Antennæ of ten joints—the first two short, thick, smooth, and equal; the rest very slender, and numerously ringed; the third is the longest, the remainder gradually decreasing; the last is widely dilated, and bears two unequal spines. Legs slender; the tibia bears a few spines at the tip. Genitalia bivalve, the valves not contiguous at their tips; the tips are rather bluntly rounded, and the hairs on the dorsal side are longer than those on the ventral surface; ovipositor slender.

Adult male similar to the female in colour and in general form. Genitalia consisting of a rather long bilobed genital plate, the lobes dilated posteriorly, the apex bluntly conical, the hairs on the lobes rather long; posterior processes cylindrical, without hooks, nearly two-thirds as long as the genital plate.

Pupa as a rule stationary, but capable of moving at will. In its earlier state, just after leaving the larval exuviæ, it is flat, elliptical, light-brown. In the later state the general outline is elliptical, the rudimentary wing-covers clearly distinct; form very convex above, flat or concave beneath. Colour of the dorsal surface a rich dark-brown, the edges yellowish; wing-covers light-brown; on the thorax are eight small yellow tubercular swellings; all round the margin is a very short, white, delicate fringe. Viewed ventrally the pupa is greenish, the legs and antennæ yellow. The abdominal region of the pupa-case is clearly divided from the thorax, and on the cephalic region is a trapezoidal plate slightly raised posteriorly. Antennæ of pupa with six joints—the first five subequal (the third the shortest); the last joint much longer, fusiform, bearing at the end two unequal spines. Legs thick; second joint of the tarsus very small; claw, pulvillus, and tarsal seta as in *T. pellucida.* Anal ring elongate, ends rounded, not very acute, slightly recurved. The marginal fringe consists of very minute cups set closely together, from which spring very short glassy sub-cylindrical tubes. Length of pupa-case varying with age: at the latest stage about $\frac{1}{11}$in.

Larva active; general colour dark-brown, the abdomen banded transversely with yellow, and the thorax exhibiting a number (six to eight) of yellow tubercles as in the pupa. Length about $\frac{1}{20}$in. Antennæ of four joints, rather thick. Margin bearing a very short fringe. Epidermis exhibiting a very large number of minute oval pores, and several groups of curly setæ.

The larval skin very often remains attached, like a tail, to the pupa after the latter has emerged.

When the adult is being hatched from the pupa a translucent watery fluid escapes on the leaf.

Hab. In New Zealand, on *Panax,* sp. var., *Pseudopanax ferox* (lancewood), &c.

This is clearly, from the wing-venation and the colours and forms of the larvæ and pupæ, a distinct species. It is larger than *T. pellucida,* and in all its stages is an extremely pretty insect.

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[All the figures are greatly magnified.]

PLATE X.

Fig. 1. Diagram of forewing of genus *Psylla*: *ab*, primary stalk of veins; *bc*, stalk of cubitus; *bd*, stalk of subcosta; *df*, radius; *cm*, *ck*, *ch*, *ce*, branches of cubitus; *dg*, secondary branch of subcosta; *agek*, costal and marginal vein; *an*, clavus.
Fig. 2. Diagram of forewing of genus *Trioza*: Letters as in fig. 1; the stalk *bc* is absent.
Fig. 3. *Rhinocola eucalypti*, adult female, dorsal view.
Fig. 4. " fore- and hind-wings; letters as in fig. 1; *ss*, stigma.
Fig. 5. " antenna of adult.
Fig. 6. " foot of adult.
Fig. 7. " genitalia of female, side view.
Fig. 8. " genitalia of male, side view.
Fig. 9. " pupa, dorsal view.
Fig. 10. " antenna of pupa.
Fig. 11. " foot of pupa.
Fig. 12. " spinnerets of pupa.
Fig. 13. " abdominal spines of pupa.
Fig. 14. " larva, dorsal view.
Fig. 15. " antenna of larva.
Fig. 16. " anal ring of pupa and larva.

PLATE XI.

Fig. 1. *Trioza pellucida*, adult female, dorsal view.
Fig. 2. " fore- and hind-wings; letters as in Plate X., fig. 2.
Fig. 3. " markings in areas of forewing.
Fig. 4. " head, dorsal view.
Fig. 5. " antenna of adult.
Fig. 6. " foot of adult.
Fig. 7. " rostrum and setæ of adult.
Fig. 8. " genitalia of female, side view.
Fig. 9. " genitalia of male, side view.
Fig. 10. " pupa, dorsal view.
Fig. 11. " antenna of pupa.
Fig. 12. " foot of pupa.
Fig. 13. " anal ring of pupa.
Fig. 14. " fringe of pupa.
Fig. 15. " larva, dorsal view.
Fig. 16. " antenna of larva.

PLATE XII.

Fig. 1. *Trioza panacis*, adult male, side view.
Fig. 2. " head of adult, dorsal view.
Fig. 3. " forewing; *bd*, stalk of subcosta.
Fig. 4. " genitalia of female, side view.
Fig. 5. " genitalia of male, side view.
Fig. 6. " antenna of adult.
Fig. 7. " pupa, dorsal view.
Fig. 8. " antenna of pupa.
Fig. 9. " fringe of pupa.
Fig. 10. " anal ring of pupa.
Fig. 11. " larva, dorsal view.
Fig. 12. " pores and setæ of larva.

Fig. 13. *Rhinocola fuchsiæ*, adult male, dorsal view.
Fig. 14. " head of adult.
Fig. 15. " forewing.
Fig. 16. " genitalia of female, dorsal view.
Fig. 17. " " side view.
Fig. 18. " antenna of adult.
Fig. 19. " genitalia of male, side view.
Fig. 20. " genital processes of male, ventral view.
Fig. 21. " pupa, dorsal view.
Fig. 22. " head of pupa.
Fig. 23. " antenna of pupa.
Fig. 24. " abdominal spines of pupa.
Fig. 25. " anal ring of pupa.

Art. XVIII.—*On some* Aleurodidæ *from New Zealand and Fiji.*

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[*Read before the Wellington Philosophical Society, 2nd October, 1889.*]

Plate XIII.

The *Aleurodidæ* are a family of homopterous insects which may be considered as intermediate between *Coccididæ* and *Aphidæ*. From both (as also from *Psyllidæ*) they differ in their divided eyes ; from Coccids they are easily distinguished by the presence in the adults of both sexes of four wings ; from Aphides they differ in the characters of their younger stages, and by the form and venation of their wings.

These insects are almost all very minute. The adults fly somewhat vigorously, and sometimes in summer may be seen hovering in clouds round trees. Their name is derived from the coating of white floury meal (ἀλεύρον = flour) with which the wings in most species are covered. The larvæ and pupæ are always attached to plants ; and in these states it is difficult at first sight to distinguish them from Coccids. Indeed, the form of an orifice situated near the abdominal extremity is about the only mark by which, in many cases, to identify an Aleurode pupa. Many of these pupæ are fairly thick and easily seen, but many others are so thin and translucent that when dry they can scarcely be detected on a leaf, and when wetted by rain or otherwise become quite invisible. They are very commonly mistaken for Coccids. I have frequently had them sent to me as such, and in 1878 I included two of them, under the generic name of *Asterochiton*, amongst Coccids ("Trans. N.Z. Inst.," 1878, vol. xi., p. 214). It requires examination under a strong lens or a microscope to make out

the form of the orifice just mentioned, and to distinguish the pupæ from—say, some kind of *Lecanium* or *Ctenochiton*.

The adult *Aleurodidæ* in most species are very much alike: the differences—an extra patch or so on the wings, or a slight variation in colour, or some peculiarity in the division of the eyes—are so small that practically the specific distinctions may be best studied in the larvæ and pupæ. Even these are not always separated by clearly-marked characters recognisable without close examination; and, on the whole, the family presents many difficulties to the student.

The bibliography of the *Aleurodidæ* is not extensive at the best; and, so far as my own studies are concerned, the only modern works available to me are Dr. Signoret's "Monographie sur les Aleurodes," 1867, and a paper by Mr. J. Douglas on a new species ("Entom. Mo. Mag.," May, 1888). Signoret enumerates and summarises some thirty writers, from Réaumur to Frauenfeld (1867), who have given various notes on the family; but most of these are either inaccurate or too brief.

As far as I can ascertain from the authors mentioned, there is only one genus, *Aleurodes*, of these insects; and to that genus I have attributed the five species described in this paper.

Genus ALEURODES, Latreille.

Insects with four wings in both sexes in the adult state. Eyes divided; a single ocellus near each eye. Antennæ of seven joints. Wings horizontal, white, floury, often patched with brown; forewing having only one median longitudinal vein, with a short basal branch. Tarsi of two joints; claws two, with a third spiny process between them. Abdomen exhibiting a tubercular process, dorsally, on the last segment. Pupæ arboreal, stationary, enclosed in a waxy test which exhibits a subovate orifice near the abdominal extremity.

Aleurodes sacchari, sp. nov. Plate XIII., figs. 1–10.

Adult female insect brown, patched with dark-yellow; antennæ and legs yellow. Body rather thick; length about $\frac{1}{20}$in.; expanse of wings nearly $\frac{1}{8}$in. Forewings white, strongly marked with dark-brown patches; one patch is at the base of the wing, and two others form clear transverse bands on the surface, leaving the tip of the wing white; there are also many smaller scattered spots. Hindwings only very faintly marked with brown spots. Median longitudinal vein of forewing strongly marked, angular; basal branch fainter, short. Abdomen having on the last segment, dorsally, a very short process (cornicle); extremity sharp, trifid, turned downwards, bearing a few short hairs at the tip. Antennæ of seven joints; the first two very short, smooth, and thick; the third

much longer; the rest subequal, a little shorter than the third; all the five last are slender, numerously ringed, and bear very short hairs. Legs very slender, longish; tibia and tarsus numerously ringed, the tibia longer than the two joints of the tarsus together. Eyes brown or dark-red, slightly convex, facetted, divided in the middle by a single median smooth space.

Adult male similar in general form and colour to the female, but smaller; length about $\frac{1}{25}$in. Wings proportionately much shorter than those of the female, not extending in repose beyond the abdomen. Abdomen exhibiting the dorsal cornicle, and ending in two rather slender cylindrical forcipate processes enclosing the penis, which is curved and slender.

Pupa stationary, enclosed in a rather solid yellow test, about $\frac{1}{20}$in. long. Viewed dorsally, the test is elliptical, the pupa appearing indistinctly through it; the thoracic portion brown, the abdominal region obscurely segmented; the abdominal orifice subcircular; there are several shortish hairs on the edge and three pairs of longer ones on the surface, one pair at the head, one median, and one at the cornicle. Viewed ventrally, the rudimentary feet can be detected. Viewed sideways, the test is of considerable thickness; the rudimentary organs project slightly on one surface and the cornicle on the other.

Larva elliptical, about $\frac{1}{45}$in. long, yellow; generally resembling the pupa, but thinner, and capable of moving. Legs short, weak, and slender. Antennæ very slender, and apparently of four joints (or six?).

Eggs oval. I cannot detect any peduncle, although this seems to be usual in the genus.

Hab. In Fiji, on sugar-cane, and rarely also on stems of grass. Mr. R. L. Holmes, of Bua, has been kind enough to send me a number of specimens.

Signoret describes ("Monographie," pp. 395–399) three species having large brown patches on the forewings—*A. bergii*, Sign., *A. abutilonea*, Haldeman, and *A. phalænoides*, Blanchard. The original description of this last, a Chilian insect living on *Cestrum parqui*, is too vague and brief for comparison, the pupa not being mentioned. Haldeman's species, on *Abutilon*, in Pennsylvania, has a circular dark patch at the tip of the forewing. The other, *A. bergii*, lives on sugar-cane in Mauritius, and seems to be closely allied to the Fijian species. Signoret had only seen the male insect, and this agrees with ours in the shortness of the wings, in the joints of the antennæ, and in one or two other particulars. At the same time, there are important differences. The wings of *A. bergii* are stated to be narrow, which those of *A. sacchari* are not, and to have their surface covered with "blackish spots, of which some are

agglomerated, especially at the tip, where they form almost a patch;" and the vein is straight: whereas the dark patches in *A. sacchari* form distinct transverse bands, leaving the tip of the wing white, and the vein is conspicuously angular. Signoret's description of the wings of *A. bergii*—"spotted with black throughout the whole length"—means indeed something quite different from the bands of *A. sacchari;* and on the whole I shall leave the Fijian insect as distinct, although probably the sugar-cane of Fiji may have been imported to that country from Mauritius originally, and in that case may have taken its Aleurode with it.

Aleurodes papillifer, sp. nov. Plate XIII., figs. 11–17.

Adult insect very light yellow; length about $\frac{1}{30}$in. Eyes red, distinctly divided, the facetted portions elongated and scarcely touching; ocellus just above each eye. Head and prothorax bent distinctly downwards. Antennæ slender, with seven joints; the first two short, thick, and smooth, the rest slender and numerously ringed; the third joint is the longest; the last bears two minute spines at the tip. Feet normal. Wings white, immaculate; on the margins many short fine hairs. Last segment of the abdomen rather long; cornicle normal.

Pupa yellow, rather thin; irregularly elliptical; length about $\frac{1}{27}$in.; surrounded by a long, white, thin, close fringe of waxy secretion. Abdominal orifice elongate. On the dorsal surface are twenty short, thick, conical papillæ, from which spring thickish waxy tubes; twelve of these are on the edge, the other eight arranged in two longitudinal dorsal series, four being near the cephalic extremity, and four on the abdominal region. Abdominal segments indistinct.

Hab. In New Zealand, on *Pittosporum eugenioides, Geniostoma ligustrifolium,* and other trees; sometimes found in countless thousands hovering about the branches.

Two European insects, *A. loniceræ,* Walker, and *A. rubi,* Sign., exhibit on the dorsum of the pupa longish hairs arranged similarly to those here described; but these hairs are slender and do not spring from thick, short papillæ. Moreover, in both of them the forewings have distinct dark patches, whereas the wing of *A. papillifer* is quite free from marks.

Aleurodes asplenii, sp. nov. Plate XIII., figs. 18–20.

Adult insect light-yellow, often with a greenish tinge; length about $\frac{1}{25}$in. General form normal; last segment of abdomen rather short. Antennæ rather long, with seven joints, of which the two first are smooth, the rest numerously ringed; the second joint is three times as long as the first;

the third is very long; the last bears at the tip two minute spines. Wings white, immaculate. Eyes red, simply divided.

Pupa white; elliptical; rather thick, with perpendicular sides; edges smooth, without hairs; dorsum slightly convex.

Larva yellow; elliptical; very thin; dorsum flat; abdominal segments indistinct; orifice ovate. Margin surrounded by a very long white fringe of loose, rather thick, waxy threads, many of which are as long as the whole breadth of the test; amongst these threads there is often a good deal of white waxy meal. No threads usually on the dorsum, but sometimes one or two may be observed on the cephalic region.

Hab. On *Asplenium lucidum* and other ferns, in New Zealand.

A. vaporariorum, Westwood, a species originally from Brazil, but apparently common in hothouses in Europe, exhibits a loose fringe of threads similar to that of our insect in the larval stage; but these threads are, with the exception of some of extreme length, much shorter than those of *A. asplenii*, and there are, moreover, many of them on the dorsal surface. I find, also, no mention in the description of Westwood's species (Sign., "Monog.," p. 387) of any great difference between the larva and the pupa. Usually, amongst *Aleurodidæ*, it is not possible to distinguish exactly between these two states; the metamorphosis takes place so gradually, and the general characters are so similar, that authors seem to write indiscriminately of one and the other. But in *A. asplenii* the white, hairless, thick pupa is so different from the yellow, thin larva, with long fringe, that they are quite distinct. A further character differentiating our species may be the adult antenna, which is very long, whereas in *A. vaporariorum* it is exceptionally short.

Aleurodes melicyti, sp. nov. Plate XIII., figs. 21–24.

Asterochiton aureus, mihi ("Trans. N.Z. Inst.," 1878, p. 216).

Adult insect yellow, slightly patched with brown; length about $\frac{1}{20}$in. General form normal. Antennæ rather long; second joint three times as long as the first; third joint rather thick, the rest slender; all numerously ringed except the two first, and bearing very short, fine hairs; on the last two minute spines at the tip. Feet normal. Rostrum short, but there is a mentum of great length, reaching to the first segment of the abdomen, trimerous, the middle joint the longest, the last conical. Wings white, probably immaculate, but there may be a faint patch near the tip.

Pupa almost circular, very thin, flat; colour of test rich-golden or orange, the pupa dark-brown; the rudimentary legs

and abdominal segments are rather plainly visible. Surface of test striated, and there are four patches of brown radiating from the pupa in the middle towards the edges; in these patches are several circular, small, tubercular marks. The edge of the test is dark-brown, seemingly containing a number of minute tubercles; but there is no sign of a fringe. Length of test about $\frac{1}{18}$in.

Hab. In New Zealand, on *Melicytus ramiflorus.*

This is a large and, from its rich colour, a handsome species in the pupa stage. It seems to be nearest to *A. proletella*, Linn., which has not, however, the radiating patches with small tubercles on the dorsum of the pupa. Misled by the apparent similarity to a Lecanid insect, I included this species, in 1878, amongst Coccids.

Aleurodes fagi, sp. nov. Plate XIII., figs. 25, 26.

Pupa dull-yellow; elliptical; length about $\frac{1}{20}$in.; rather thick, with perpendicular sides which are slightly overlapped by the dorsal disk; enclosed insect indistinctly visible, the abdominal segments rather clearly marked. Dorsum slightly convex, finely striated. No fringe, but round the edge are twenty-four rather strong hairs, at about equal intervals.

Hab. In New Zealand, on *Fagus menziesii.* Specimens sent to me by Mr. R. Raithby, of Inangahua.

The arrangement of the hairs, and the size of the dorsal disk in this pupa as compared with the ventral surface, seem to be distinguishing characters. I have not seen the adult.

Aleurodes simplex, sp. nov. Plate XIII., fig. 27.

Pupa very light yellow, sometimes nearly white; elliptical, very slightly convex, texture very thin; length about $\frac{1}{23}$in. Rudimentary organs scarcely to be made out. Edge rather thicker than the rest, and finely striated, but there is no fringe. Abdominal extremity distinctly cleft (as in the Coccid genus *Lecanium*); abdominal orifice elongated, situated at the inner end of the cleft. On the dorsal region are several hairs, which do not spring from conical papillæ.

Adult unknown.

Hab. On *Pittosporum eugenioides, Coprosma lucida,* and several other trees in New Zealand.

This species in the general form of the pupa resembles *A. rubi*, Signoret, and *A. fragariæ*, Walker, and both of these have similar dorsal hairs; but the abdominal cleft appears to be distinctive.

[In 1878 ("Trans. N.Z. Inst.," vol. xi., p. 215) I included amongst Coccids two insects really *Aleurodidæ*, under the generic name of *Asterochiton*. *Ast. aureus* is *Aleurodes melicyti*

of the present paper; *Ast. lecanioides* appears to have been made up of both *Aleurodes papillifer* and *A. simplex*.]

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Art. XIX.—*The Wattle-blight* (Icerya purchasi) *in Tasmania, and its Natural Enemies.*

By Jas. Hudson, M.B.

[*Read before the Nelson Philosophical Society, 4th April, 1889.*]

The ravages of this blight on our acacias and wattle-trees are well known. It seems to have a special liking for plants of the natural order *Leguminosæ* (gorse and broom, &c.), but it also attacks, and that most disastrously, orange- and lemon-trees. I know many instances of lemon-trees in Auckland and Nelson which formerly bore splendidly, but which now, owing to this blight, give their owners scarcely any fruit. You may frequently find it also in rose-bushes, and it is said to affect pines, cypresses, and grass. The insect, like most of the *Coccididæ*, is at first active; soon, however, it bores through the bark of some twig, which it selects, with its proboscis, and

commences to suck up the juices of the plant. It grows rapidly, and soon begins to secrete its characteristic cottony exudation: this is in reality the ovisac, and in a fully-developed female is found full of little red eggs to the number of two or three hundred. The male is a winged insect, about ⅛in. long: it may be frequently seen in wattles infested with the *Icerya.*

There is one peculiarity which this creature shares with many of the *Hemiptera*—viz., the power of secreting honey-dew. You may frequently observe a drop of this exuding from its posterior extremity. Every one must have noticed the blackened stems of trees affected with this blight: this is indirectly caused by this honey-dew—in this way: the insect scatters the honey-dew over the stems of the plant, and in this honey-dew various species of black fungi grow, which give to the plant-stems the black, sooty appearance.

While at Launceston, in Tasmania, in the early part of January of the present year, I took a walk along the banks of the South Esk. I could not help observing the numerous wattles, and how healthy and luxuriant they appeared ; and I at first concluded that that district must be free from the *Icerya.* However, I soon observed one or two of the trunks having black patches on them, and, knowing this to be indicative of blight, I was induced to examine them more carefully. I soon found a group of perfect specimens, stuck on by the proboscis in the usual way; and on tearing open the posterior cottony exudation I found it full of the little red eggs of the insect, so the identity was perfect.

We have long known that ladybirds are great blight-eaters, and when I saw that the *Iceryæ* were there, and yet that they did not do much damage, I at once looked for ladybirds, and I soon found some, one of which I secured, and I now show it to the society. You will observe that it is larger than the ordinary New Zealand species; further, it is covered with rather large black spots symmetrically arranged on a reddish-orange ground. I did not see the ladybirds actually eating the *Iceryæ,* though I make no doubt they do so, but I came across some larvæ which were feeding on them most voraciously. I saw one with his head buried in the cottony exudation, no doubt feeding on the eggs inside. These larvæ were short, hairy, nearly black in colour, with six legs, no prolegs, and a divided spike-like projection posteriorly. I also found a small group of about twenty or thirty eggs stuck on to the bark of one of the wattles. These eggs were of peculiar shape, elongated, with their long axes vertical to the tree. I cut out the piece of bark with them on, intending to bring them to Nelson; but, alas! it was in the full heat of an Australian summer, and when I looked at them a few days later I found they had all hatched; but from what I could see of the little

black creatures that had come out they assimilated in appearance to the larvæ I had seen devouring the *Iceryæ*.

In looking for the ladybirds I could not help observing that the wattle-trees were completely overrun with ants—small black ants, similar in appearance to what are abundant in England. I had long known how fond ants are of honey-dew, and I surmised at once that they were after the honey-dew of the *Iceryæ*. I watched them smoothing the *Iceryæ* with their antennæ: this may be a way of stimulating the flow of the honey-dew. I further observed, to my astonishment, that the ants had built numerous nests, which I shall hereafter call stables, over portions of the trunks of the wattles: these were composed of the semi-decayed fine needle-like leaves of the wattle, and rubbish off the ground, loosely stuck together with the exuded gum from the wattle itself. The least crack in the bark of a wattle, such as might be caused by its natural expansion, will be followed by a gum-like exudation, and this is made use of by the ants to cement their stables. It is quite possible that the ants may purposely wound the wattle. A great many of these stables were empty (*i.e.*, there were no living creatures inside), but lots of them were teeming with ants, and also contained a variable number—from five to thirty or more—of *Iceryæ*, adherent by their probosces to the bark in the usual way, but with very little cottony exudation, and never any eggs (at least, on all that I examined). My deductions from these observations are—

1. Ants are very fond of the honey-dew of the *Icerya purchasi*.

2. They very probably obtain it from them by a voluntary effort on the part of the ant.

3. By penning them up in these stables that I have described, they prevent the access of the winged male, so that the whole of the food of the *Icerya* goes to the production of honey-dew, instead of the formation of eggs, so that the multiplication of the creature is greatly lessened, while its individual life may not improbably be prolonged.

4. The deserted stables I found were those in which all the *Iceryæ* had expired.

5. Probably the ants had their real germinating nests in the ground, only using these stables for food-supply.

I have lately ascertained that the ladybird is a species of *Coccinella*.

ART. XX.—*An Entomological Tour on the Table-land of Mount Arthur.*

By G. V. HUDSON, F.E.S.

[*Read before the Wellington Philosophical Society, 10th July, 1889.*]

DURING the past summer I spent a week on the Table-land of Mount Arthur for the purpose of investigating the insect fauna of the locality; and, as it presents some marked and interesting peculiarities, perhaps it may be desirable to place my observations on record, and also, for the benefit of future naturalists, a few practical hints as to the best way of reaching the locality, and what to do when there.

Mount Arthur, as most are aware, is the highest peak on the western side of Blind Bay, and is always a conspicuous object from the Town of Nelson. The Table-land is situated behind the mountain-range—that is, on the north-western side of it—and extends for about ten miles in the same direction till we reach Mount Peel. Its width is not so great, being, I should say, from five to eight miles; but, owing to the broken nature of the country, it is extremely hard to say, especially as there is so much high land all round. This plateau varies from 3,600ft. to 4,000ft. above the sea-level, and is covered with mountain-birch, traversed by many singular openings, which support a dense growth of tussock-grass and numerous alpine plants. The mountains easily accessible are Gordon's Pyramid (4,600ft.), Mount Arthur (5,800ft.), and Mount Peel (5,500ft.). The varying elevations which are traversed in ascending these give the naturalist a rare opportunity of observing and collecting an extremely interesting series of alpine plants and insects. Respecting the former I can give no information, but feel sure that a visit to the Table-land would amply repay any botanist who was not afraid of a little hard work. As to the best means of reaching the Table-land, it, of course, depends entirely upon whether we make Nelson or Motueka the baso of operations. In either case a horse and trap are required; but, while a whole day's driving is necessary from Nelson, less than half the time is needed to reach the Graham River from Motueka. This is a small branch of the Motueka River, which rises in the Mount Arthur Range, and flows into the main stream about fifteen miles above the town. After crossing the Motueka a short distance above the mouth of the Graham, a fairly good road takes us to Heath's, where it is usually convenient to stop the night before continuing the journey. Arrangements can also be made with Mr. Heath to carry the bulk of one's impedimenta

by packhorse on to the Table-land, which is a great assistance, especially as it is necessary to take provisions for the whole time one intends to remain there, and an abundance of clothing to put on during the cold nights.

As soon as the usual hideous stratum of burnt logs, which surrounds almost all cultivation in New Zealand, is passed, the forest becomes extremely beautiful, and the views which one obtains from the track, as it passes up the side of the Graham River, are really very fine. About four hours' hard climbing from Heath's brings us to the saddle, at an altitude of about 3,000ft. above the sea-level. Here the source of the River Pearse is crossed, where several interesting *Neuroptera* can be captured, a delicate species allied to *Hemerobius* being one of the most conspicuous. Just before we cross this stream a fine view of Mount Arthur is to be seen through an opening in the trees. From this point the track gradually descends, following the bed of Flora Creek for a matter of ten miles, and passing through dense birch forest all the way. Here on favourable days in January and February may be seen the rare and beautiful *Dodonidia helmsii* flying quietly about in and out of the sunshine, and settling on the branches just out of reach. I may state that four specimens of this butterfly only have at present been taken, and that the British Museum is much in want of a type; so perhaps visitors to this locality may be good enough to look out for the insect and obtain them one. I think it will be found on most of the wooded hills in Nelson Province between 2,500ft. and 3,000ft., as I took a poor specimen on the Dun Mountain (1885), in quite a different neighbourhood. It is also said to have occurred on the hills the other side of Wellington Harbour, but I have not seen it.

About two miles after we leave the source of the Pearse a small clearing is reached, called "Flora Camp," which is a convenient halting-ground for those who wish to ascend Mount Arthur without visiting the Table-land, as a branch track can be followed up shortly after we leave the saddle, leading directly on to the mountain.

The track along Flora Creek in many places presents a most picturesque appearance, the numerous waterfalls and the gradual increase in the size of the stream being features of especial interest. To an entomologist with a tent and plenty of time no doubt a day would be well spent here, collecting *Neuroptera* over the stream, *Micro-Lepidoptera*, and sugaring the trees at night for moths. Mr. Meyrick mentions, in his article on the New Zealand *Noctuina* ("Trans. N.Z. Inst." for 1886), that he tried sugaring on the Table-land with no result; but I feel sure that, had he sugared in the forest (where there are not nearly so many flowers), his labours would have

been rewarded. I recollect sugaring one evening in the Botanical Gardens, Wellington, in a small gully, less than a quarter of a mile away from some most attractive flowers, and obtaining a large number of insects at the bait; while had I tried it nearer the flowers the results would have been unquestionably *nil.*

About three miles before we reach the first opening on the Table-land the track leaves the bed of Flora Creek and starts to ascend very rapidly, following the course of a small stream which rises in Salisbury's Opening, near the first hut that is reached. This hut, however, is now quite unfit to stop in; but there are several others in various parts of the Table-land that can be used, and are far warmer than a tent, which is not a sufficient protection against the cold at so great an elevation above the sea-level.

It is much to be regretted that the means cannot be found to construct a really serviceable hut, containing one or two rough bunks and a bench, for the use of naturalists and others, as I feel satisfied that directly this locality is better known it will be far more frequently visited, on account of the obvious beauties of the scenery and the excessive interest of its biological productions. When, moreover, we consider the comparative proximity of the Table-land to Wellington, I think it will be admitted that the accomplishment of this scheme would not be entirely outside the scope of our society, one of whose chief functions is, if I understand correctly, to assist naturalists in original researches.

Acting on Mr. Meyrick's suggestion ("Trans.," vol. xix., p. 4), I took a kerosene-lamp with me to the Table-land, and lit up at dusk on the first evening (22nd January). The night was slightly overcast, with a few drops of rain, and much warmer than usual, the result being that several good moths were captured at the lamp, including three specimens of *Leucania propria*, several *Mamestra rubescens*, and a rare *Bombyx*, besides several *Scoparia trivirgata.*

The next day (23rd January) I decided to ascend Mount Arthur, and left the hut at 7.30, the weather being everything that could be desired. A few minutes' walk brought us to the foot of Gordon's Pyramid, where the track was soon discovered, and followed up until the bush-line was passed, at about 4,000ft. I had better, perhaps, mention that this portion of the forest is very rough, and it is most necessary to exercise great care in keeping to the track, which, however, is now well marked by numerous blazes made during two successive visits. After leaving the forest the vegetation is very rank, consisting of a great variety of alpine plants, tussock, &c. Here in the hot sunshine occurred *Harmologa siræa* in great numbers, in the finest condition, flying with much agility,

besides large numbers of *Notoreas paradelpha*, *Harmologa latomana*, and *Tauroscopa gorgopis*. Two specimens of *Erebia pluto* were taken on a patch of shingle at about 4,200ft., but this must be regarded as an exceptionally low elevation for the species.

On arriving at the top of the Pyramid a long descent is made to reach the Mount Arthur Range proper, and it is here that probably the best collecting on the Table-land is to be found. *Metacrias erichrysa* was frequently seen dashing about in the hot sunshine, and was extremely difficult to catch. Two other *Bombyces* (?) were also obtained which are not yet identified, but any moths belonging to the group are of extreme interest, owing to the singular absence of its members from the fauna of the lowlands in New Zealand. High up, at about 4,800ft., *Stathmonyma anceps* was found, the dark-grey forewings harmonising admirably with the rocks on which it perches; besides specimens of *Orocrambus mylites* and *catacaustus*. These insects occurred up to the extreme top of the mountain, as well as *Erebia pluto*, which was very abundant on the shingle-flats above 5,000ft.

I must confess that the ascent of the last 800ft. of the mountain considerably alarmed me, although no doubt the dangers are nothing in the eyes of more experienced climbers.

On the top we discovered the names of previous visitors, and during the half-hour spent there I noticed numerous specimens of *Erebia pluto* and *Orocrambus*, so I am disposed to think that their range of elevation would be considerably more extended on a higher mountain; but of course this is a matter for future observation. Above 5,000ft. the only common plant is a fine wiry grass, which I conjecture is the food-plant of these insects. The discovery of the larva of *Erebia pluto* would be of excessive interest, and the insect might probably be reared by any one who was able to spend two or three months on the Table-land, as I think the females would readily lay their eggs in captivity, if the young larvæ could not be found. An accurate record of the times of appearance of these alpine insects would also be extremely valuable, which of course could only be obtained by a naturalist residing on the Table-land during the whole summer.

During the descent numerous stoppages were made to obtain insects, *Erebia pluto* continuing extremely abundant until we left the shingle and snow. Lower down a few *Coleoptera* were obtained by beating spear-grass blossoms; but the *Lepidoptera* absorbed most of our attention. It was curious to make the acquaintance here of *Dasyuris partheniata*, a species found on the cliffs above the Hermit's Cave, Wellington, but nowhere, as far as I know, on the sea-level in Nelson Province. When the top of Gordon's Pyramid was

again reached, at 6 o'clock, I was startled to see a conspicuous black insect flying about, which I felt sure was not *Erebia pluto*. On capturing it, I at first took it be *Erebia butleri*, but subsequent examination proved that it was not a butterfly at all, but *Stathmonyma hectori*. A rapid descent soon took us through the forest, which appeared extremely beautiful in the evening sunshine, and so terminated one of the pleasantest days I have ever spent.

Tuesday, 24th January, was occupied in collecting about Salisbury's Opening, round the base of Gordon's Pyramid. The sun was very hot, and nearly every tussock was enlivened by the presence of *Argyrophenga antipodum*, which is pre-eminently the butterfly of the Table-land. It will be seen how widely the specimens of this insect taken here differ from those from Christchurch and the Dun Mountain, and individuals from other localities would probably exhibit further aberrations. The number of ocelli on the wings varies exceedingly—one specimen in my collection has them almost completely suppressed.

Of the large *Crambi*, *Crambus crenæus* is the commonest species, but it is with difficulty distinguished from *C. isochytus* on the wing. *Crambus siriellus* is a finely-marked species, and a good series can be obtained with a little perseverance; but I understand from Mr. Meyrick that it is by no means confined to the alpine or subalpine regions, being found extensively on the lowlands. The brilliant little *Crambus heliotes* may be seen flying about, like swarms of small flies, in wet places, and is usually very common. Near the track, where it leaves the forest, a fine species of *Hepialus* occurred, of which I managed to secure four specimens in all. It is said to be only a variety of *Hepialus variolaris*, a lowland insect, but I feel almost sure that it is an abundantly distinct species. Other species taken were *Arcteuthes chrysopeda*, *Notoreas paradelpha*, and a curious light form of *Chrysophanus boldenarum*, which was abundant on the shingle round the stream.

The morning of Friday, the 25th, was devoted to the Limestone Caves, which are often rather difficult to find; but directions can be easily obtained from Mr. Heath or the miners. In one of these a very remarkable orthopterous insect occurred. I regret to say that I was only able to obtain three male specimens. They are extremely active, and can leap 2ft. or 3ft. at a time; their capture is consequently attended with much difficulty in a dark cave, where one can only look about with a single candle. I much wanted to ascertain the food of the insects, but the caves seem devoid of any kind of fungoid vegetation which I should imagine that they would be likely to eat. No *Coleoptera* were observed; and, in fact, the only other insect was

the luminous dipterous larva, which on examination proved identical with those found on the banks of streams in the forest round Wellington. In the afternoon we visited a singular gorge, chiefly remarkable for its steep sides, and a large rock at the entrance, in the middle of the stream, somewhat resembling a sphynx in shape. This place is well worth visiting, and can be easily found by following down the first large stream which crosses the southern end of Salisbury's Opening. A peculiar species of ranunculus was abundant on the steep sides, and many other rare-looking plants. The insects taken were numerous, comprising, amongst the *Geometrina*, *Larentia bryopis*, *Cidaria purpurifera*, *Epyaxa semifissata*, *Larentia clarata*, and *Boarmia productata*. Of *Pyralidina* the genus *Scoparia* was, as might be expected, strongly represented, the following species being taken flying about the rocks: *Scoparia philerga*, *S. cymatias*, *S. trivirgata*, *Xeroscopa niphospora*, *X. cyameuta*, *X. rotuella*, *Diptychophora interrupta*, *Œcophora griseata*, and many other *Micro-Lepidoptera*. In fact, the locality is so productive that I devoted two other afternoons to collecting there, and should strongly recommend any entomologist visiting the Table-land to give it his close attention. On Sunday, the 27th January, I decided to work Mount Peel and the neighbourhood, and made an early start in the morning, arriving on the top of the mountain at about 11 o'clock. On our ascent, *Notoreas paradelpha* was common at about 4,000ft., where a black species of *Pyronata* also occurred. The first snow was met with at about 5,000ft., and shortly afterwards we again fell in with *Erebia pluto*, but not so commonly as on Mount Arthur. As, however, Mount Peel is so much better suited to collecting, a larger and finer series was taken here than on the former. I was also astonished to meet with the odd little *Chrysophanus boldenarum* up here. The butterfly is said to frequent river-beds in the South Island; but I am inclined to think that it is far more widely distributed, and have seen large numbers in Wellington Province. A fine species of *Locustidæ* was also abundant on the rocks, and completely protective in its colouring. The same species occurred on Mount Arthur, and in both localities the insects were quite invisible when motionless. On returning, a visit was made to Lake Peel, where several specimens of the alpine cicada (*Cicada cassiope*, Hud., MS. name) were secured, as well as *Stathmonyma hectori* and other interesting insects.

Monday, the 28th, was devoted to setting specimens and collecting in the gorge, and on Tuesday we left the Tableland, meeting with three specimens of *Dodonidia helmsii* on the track, all of which were unfortunately out of reach.

Perhaps a few notes on the lowland insects observed in

this locality may be of some interest, as showing the range of altitude exhibited by many species. Amongst the butterflies, *Vanessa gonerilla* and *Chrysophanus salustius* were occasionally met with at about 3,200ft. They did not exhibit any noticeable divergence from the type. *Agrotis nullifera* was once taken at light, also *Scoparia diphtheralis*, both being normal forms. *Crambus flexuosellus*, *Boarmia productata*, and *B. melinata* occurred occasionally from 2,000ft. to 3,500ft., but were not very common. In all the specimens the markings were somewhat darker than usual.

Petalura carovei, the great dragon-fly of New Zealand, was very abundant in swampy localities round Salisbury's Opening. I did not see any specimens above 4,000ft., while the smaller *Libellula smithi*, *Agrion colensonis*, and *A. zealandica* were swarming almost everywhere, extending up to the top of the mountain. The ordinary flesh-flies (*Calliphora quadrimaculata*, *Sarcophaga læmica*, &c.) were, as usual, everywhere. I noticed many specimens on the top of Mount Arthur while eating my lunch. I am quite at a loss to understand what supports such large numbers of these insects in such remote localities, and can only conjecture that they are endowed with an extremely keen sense of smell, and travel great distances in search of food.

Among *Coleoptera*, *Pyronota festiva* was everywhere abundant, and was perhaps slightly larger and more brilliant in colouring than the ordinary form, although I think specifically identical. *Ceratognathus foveolatus* occurred under the bark of the mountain-birch; but, as I have before mentioned, I did not devote sufficient time to this order to judge at all accurately of its prevalence.

An inspection of the insects taken, arranged according to the elevation at which they occurred, will, I think, at once show that as the mountains are ascended the *Lepidoptera* become decidedly darker in colour. This has long been observed in other countries, but I think it is interesting to be able to contribute further evidence from New Zealand. Respecting the cause of this peculiar phenomenon, there seems to be little doubt that it is owing to the low temperature existing at high altitudes, as the same effect has been produced artificially by retarding, by means of an icehouse, the development of three species of European moths (*Selenia illustraria*, *illunaria*, and *alniaria*), of which Mr. Merrifield gives a most interesting account in the "Transactions" of the Entomological Society for 1889. Lord Walsingham has long ago suggested that a darker colouring, or melanism, is advantageous to alpine and arctic insects, as it enables them to absorb the sun's rays much more rapidly than if they were of a lighter hue; and he instances, as an example, the simultaneous emergence of a

white and a black insect from the pupa in a stormy and cold climate, such as we have in the alpine regions. A passing gleam of sunshine would enable the black insect to dry its wings, fly away, and propagate its species before the white one was nearly developed, and consequently there would be a continual selection in favour of the darkest varieties. This theory, I believe, is the true explanation of the singular prevalence of melanic species at high elevations, and may, of course, be equally well applied to those dark varieties and species of insects which have hitherto been almost invariably taken in the arctic regions. That there is a marked tendency to a darker coloration in the *Lepidoptera* from the Mount Arthur district as we ascend in altitude, I do not think any one can for a moment dispute who examines the representative collection now before the Society.

I must refer those wishing to learn further particulars in connection with this most interesting subject to the abstract of Lord Walsingham's paper contained in the "Entomologist," vol. xviii., page 81.

In conclusion, I should like to give a very striking instance of protective colouring which I observed when on a previous visit to the Table-land in 1888. While gathering some small branches from a birch-tree I discovered a beautifully-variegated larva, imitating exactly the delicate hues of the lichen-covered twigs. After feeding on the birch-leaves for a few days it spun up, and emerged as a very grey form of *Declana floccosa* on the 7th June. I have often seen the larva of this insect, as before mentioned ("Trans. N.Z. Inst.," 1888, p. 190), round Wellington, where, however, it does not in the least resemble the curious caterpillar found on the Table-land. This circumstance, I think, gives us a hint as to the means by which alpine insects may have assumed some of their peculiarities.

In connection with my previous visit to the Table-land in 1888 I should also mention that it was three weeks later in the year than in 1889, and I noticed great differences in the insects observed: for instance, in February, 1888, *Stathmonyma anceps* was very abundant, *Erebia pluto* scarce, *Rhyssa antipodum* one taken and three or four seen, *Cladopais mirus* very common. In January, 1889, I found *S. anceps* was rare, *E. pluto* very abundant, and of *R. antipodum* and *Cladopais mirus* I neither saw nor captured a single specimen. This shows that there is a rapid succession of insect-life on the mountains, which can only be properly studied by numerous and prolonged visits of entomologists.

ART. XXI.—Eristalis tenax *and* Musca vomitoria *in New Zealand*.

By G. V. HUDSON, F.E.S.

[*Read before the Wellington Philosophical Society, 2nd October, 1889.*]

1. ERISTALIS TENAX.

EARLY last spring (1888) I observed a large dipterous insect in the Botanical Gardens here, which I had not seen before in New Zealand, but soon recognised it as the common drone-fly of England (*E. tenax*). This species is especially interesting as it exhibits such a close superficial resemblance to the hive-bee (*Apis mellifica*) that any one but an entomologist would experience considerable difficulty in separating the two insects, although, of course, structurally they are totally different, belonging as they do to two entirely distinct orders of *Insecta*, the *Diptera* and the *Hymenoptera*.

The resemblance in this case is, in fact, a very perfect instance of "mimicry," the harmless dipteron having assumed the external appearance of the formidable hymenopteron, and thus become shielded from many enemies. That this acquired resemblance has effectually aided the insect in its past career can be immediately seen from its great abundance, and almost universal distribution throughout the world.

The favourable influence of civilisation on this insect must not, however, be overlooked, as the formation of ditches, cess-pits, &c., incidental to the arrival of man has afforded its larvæ numerous breeding-places which formerly did not exist, whilst the propagation of the hive-bee has also no doubt indirectly assisted in increasing its numbers by maintaining that dread among the insectivorous animals which the appearance of a bee is usually sufficient to inspire, and thus to a large extent preserving it from being eaten or otherwise destroyed.

During last April I counted upwards of thirty drone-flies on a small patch of marigolds, and noticed large numbers on the hills between Karori and Wadestown, so that it is evidently increasing here quite as rapidly as elsewhere. It will consequently be interesting in the future to observe the influence that *Eristalis tenax* exerts on its aboriginal relatives, such as *E. cingulatus*, *Helophilus trilineatus*, *ineptus*, &c., as, judging from the behaviour of other northern importations, it should largely supersede them, especially when we consider how efficiently it is protected by its resemblance to a common and powerfully-armed insect. The ultimate extinction of the indigenous species of *Eristalis* and *Helophilus* by this mimetic species would consequently seem not improbable.

It might perhaps be well to mention here that the universal superiority which the northern animals exhibit when competing with the natives of southern latitudes in the struggle for existence is attributed by Darwin to the severe competition which has so long existed amongst the organisms in the northern hemisphere, chiefly owing to the great extent of the land in those regions compared with isolated areas such as New Zealand and other oceanic islands. It is needless to say that we see the words of that great naturalist verified daily, as both the native plants and animals are constantly being supplanted by northern forms.

2. Musca vomitoria.

During last June (1889) I observed on my sitting-room window a specimen of this familiar European insect. Formerly I have often been astonished at its absence from New Zealand, seeing that the ubiquitous *Musca domestica* so long ago obtained a footing, and is now so exceedingly common everywhere. It is consequently somewhat strange that this almost equally abundant species has until so very recently been unable to procure a passage. However, now that it has arrived, the process of naturalisation appears to be progressing rapidly, as I have seen upwards of five specimens during September in various localities, including three in the Botanical Gardens. In habits and appearance this insect closely resembles the larger of our native species of flesh-flies, but may be easily recognised by its pale-blue abdomen striped with black. It will no doubt increase enormously in numbers, and perhaps largely, if not completely, supplant the New Zealand flies. As all these insects have many generations in one summer, the process of competition between the several species should not be a difficult matter to observe.

For those desirous of knowing the economic influence these two new dipterons are likely to exert in New Zealand, it may be satisfactory for them to hear that *Eristalis tenax* is quite harmless in all its stages, the larvæ feeding on the putrid mud at the bottoms of ditches, where it obtains air by means of a remarkable telescopic tube at its posterior extremity, capable of being adjusted to the exact depth at which it happens to be situated from the surface. As to *Musca vomitoria*, it is only an additional scavenger who will industriously remove effete animal matter from the surface of the earth, and as such we need not feel at all sorry it has come here, for, although the flesh-flies are no doubt often very inconvenient, the immense sanitary benefits they confer on mankind can hardly be overestimated.

ART. XXII.—*Revision of the New Zealand* Idoteidæ.

By CHARLES CHILTON, M.A., B.Sc.

[*Read before the Otago Institute, 12th November, 1889.*]

DURING the past year I obtained some specimens that revealed a few new facts bearing on the New Zealand *Idoteidæ,* and, as I had to examine some of the species pretty carefully, I decided to overhaul all recorded from New Zealand; and the following paper is the result.

I add one species—viz., *Idotea peronii,* M.-Edwards—to the list of those found in New Zealand; reduce *Edotia dilatata,* Thomson, to a synonym of *Idotea elongata,* Miers; and omit *Idotea margaritacea,* Dana, as it is, according to Miers, in all probability the same as *I. metallica,* and in any case it belongs to Australia rather than to New Zealand. At the same time, I am able to settle a few points hitherto uncertain in the synonymy of some of the species, and also to give some additional information regarding them.

The species recorded from New Zealand are now eight (8) in number—viz., seven *Idoteas* and one *Cleantis*—and of these I have seen all but *Idotea marina.* It will be interesting to recapitulate what is known of their distribution. Two—*I. marina* and *I. metallica*—are almost cosmopolitan, the latter being pelagic in habit, but the former only has hitherto been recorded from Australia; three—*I. peronii, I. ungulata,* and *I. elongata*—are widely distributed in the southern seas, *I. peronii* being known from Australia, Tasmania, New Zealand, and the Cape of Good Hope, *I. ungulata* from the Indian Ocean, the coasts of South America, Cape of Good Hope, Australia, Auckland Islands, Falkland Islands, and New Zealand, and *I. elongata* from New Zealand, the Auckland Islands, and the Falkland Islands, but not as yet from Australia, though it is worth noting that the Australian specimens of *I. ungulata* that I have examined are to a considerable degree intermediate between that species and *I. elongata;* two species—*Idotea festiva* and *Cleantis tubicola*—are known from New Zealand only, the latter apparently being closely allied to *C. granulosa,* Heller, from St. Paul's; the remaining species, *Idotea lacustris,* is found in New Zealand only, in a lagoon of fresh water situated close to the ocean, and is probably identical with a species, presumably marine, from the Straits of Magellan.

The distribution of these *Idoteidæ* thus appears to confirm the argument drawn by Professor Parker* from the distribu-

* "Trans. N.Z. Inst.," xix., p. 154.

tion of *Palinurus* in favour of Professor Hutton's theory* of an antarctic continent, from which the great southern land-masses were stocked.

It appears from Miers's "Revision of the *Idoteidæ*" that there are only five distinct species recorded from Britain, and four, with a doubtful fifth (*I. margaritacea*), from Australia, so that, according to our present knowledge, the group is better represented in New Zealand. It must not, however, be assumed that our knowledge of the New Zealand forms is by any means complete. Thus, *Idotea festiva* and *Cleantis tubicola* are known from single specimens only, and I have in addition a specimen from Lyttelton, which, though too small and immature for identification, certainly does not belong to any of the recorded New Zealand species, but appears to come nearer to *Idotea acuminata.*

I have dissected and examined the three species, *I. lacustris*, *I. ungulata*, and *I. elongata*, in some detail, but the results are not sufficiently important to justify a minute description of their different parts. It is, however, evident that *I. ungulata* and *I. elongata* are both much more specialised than *I. lacustris*, and depart further from the parent species from which the *Idoteidæ* are descended. Thus, in them the segments of the postabdomen are more anchylosed together; the epimera are not so well developed, and are more or less joined to their respective segments; there is no trace of the second ramus articulating with the basal plate of the operculum, and the same tendency is seen in the mouth parts. Of the two, again, *I. elongata* is more specialised than *I. ungulata*. *I. peronii* appears to come near to the latter species, but I have not examined it in such detail.

It is perhaps worth while drawing attention to the fact mentioned below, that the coalescence of the segments of the postabdomen is subject to considerable variation in the same species, and that hence the number of segments of the postabdomen, though a useful character for dividing the species into artificial groups, cannot be relied upon very far to indicate the natural affinities of the different species.

After some consideration, I have decided to give full descriptions of all the species. Most of these have already appeared elsewhere, but they are somewhat scattered, and are not easily accessible to New Zealand students. Those which are not original are placed in inverted commas, and have the author's name given at the end in brackets.

I have not attempted to give the full synonymy, but I have endeavoured in each case to give those references which will be required by New Zealand students, and also the reference

* "N.Z. Journal of Science," vol. ii., p. 1.

to Miers's exhaustive revision of the family, where the full synonymy will be found.

I am indebted for specimens to Mr. R. M. Laing, of Lyttelton, to the Trustees of the Australian Museum, and particularly to Mr. G. M. Thomson, who placed at my disposal all the *Idoteidæ* in his collection, including the types of the species described by him.

IDOTEA MARINA.

Idotea marina, Miers, "Jour. Linn. Soc. Zoology," vol. xvi., p. 25 (1881). (The complete synonymy is given in the work quoted.)

"Body smooth, moderately convex, and not tuberculated or rugose. Head with the antero-lateral angles very little prominent and rounded, the anterior margin very slightly emarginate. First thoracic segment with the antero-lateral lobes subacute, and not quite reaching to the eyes. Post-abdomen about equalling in length the five preceding thoracic segments; terminal segment with the sides straight and slightly convergent to the distal extremity, which is usually more or less tridentate, with the postero-lateral lobes (or lateral teeth) rounded and much less prominent than the median tooth, which is obtuse; there are usually more or less marked indications of a median keel on the dorsal surface of the segment. In other, even adult examples, there are no indications of any except the median tooth. Eyes small. Antennules with the basal joint little dilated, not reaching beyond the penultimate joint of the peduncle of the antennæ in the adult. Antennæ, when retracted, about reaching to the posterior margin of the fourth thoracic segment, with the last peduncular joint a little longer than the preceding; flagellum with not more than twenty joints, and usually about sixteen in the adult. Legs slender; epimera of second to fourth segments more or less oblong, and reaching to the posterior margin of the segment; those of sixth and seventh segments with the postero-lateral angles acute. Posterior plates of the operculum suboblong, longer than broad in the adult. Colour very variable. Length of an adult male does not usually exceed 1⅛in. (30mm.), breadth rather more than ⅜in. (9mm.)."—[MIERS.]

The description given above is taken from Miers's "Revision of the *Idoteidæ*." The species has a very wide range, being found in Europe, North America, South America (Rio Janeiro), Australia, Java, &c. The occurrence of the species in New Zealand is given by Miers on the authority of a specimen in the Paris Collection (M. Petit).

I know the species both through Miers's description and from a specimen from Whitby, England, kindly sent to me by

the Rev. T. R. R. Stebbing; but I have never collected anything like it in New Zealand, and, so far as I know, it has not been taken by any other New Zealand collector.

IDOTEA FESTIVA.

Idotea festiva, Chilton, "N.Z. Jour. of Science," vol. ii., p. 320 (1884); "Ann. and Mag. Nat. Hist.," ser. v., vol. xv., p. 123, pl. 5A, figs. 1–3 (1885).

Idotea festiva, Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 156 (1886).

Body not very convex, oblong-oval; length about two-and-a-half times the greatest breadth. Head transverse, produced upwards and forwards into a rounded prominence divided into two lobes by a median depression, which is continued nearly to the posterior margin; remainder of the head variously sculptured, and with two raised ridges towards the lateral borders. First five segments of the thorax of nearly equal length, sixth and seventh shorter, seventh shorter than the sixth. First segment produced into two rounded antero-lateral lobes, which reach to the eyes. Two raised ridges, one near each lateral border, run throughout the whole length of the thorax, and extend nearly to the end of the postabdomen. There is also a less perfect median ridge formed by the posterior portion of each segment being raised into two short converging ridges, like the letter V. This ridge is well marked in the postabdomen, and extends right to the end. Between the lateral ridges and the median ridge, but nearer to the former, are various sculptured markings. Postabdomen about as long as the five preceding segments of the thorax, composed of three distinct segments, the first two short, the third with the lateral sutures of another segment. Postabdomen gradually narrowing until about one-third of its length from the end, when it suddenly contracts and converges with slightly sinuous margins to the extremity, which is subacute. Eyes small, situated on the lateral margin of the head at the postero-lateral angle. Antennules* reaching nearly to the end of the third segment of the peduncle of the antennæ;* penultimate segment expanding distally, terminal segment very small. Antennæ* as long as the head and first two segments of thorax; last segment of peduncle longer than the preceding, but slightly shorter than the flagellum, which is composed (in the single specimen) of seven joints, of which the first is considerably longer than any of the succeeding. Epimera of only the last three segments of thorax visible in dorsal view; in side view they are all rectangular, those of second and third segments

* These words were by an error interchanged in the original description.

not reaching to the anterior end of the epimeron of succeeding segment. Opercular plates subtriangular, with slightly-raised border on inner margin; terminal plates very small, triangular, ending acutely. Legs short, not visible in dorsal view. Colour greyish. Length, 10mm.; breadth, (about) 4mm.

Hab. Sumner, Canterbury, New Zealand.

A single specimen taken on the under-surface of a boulder exposed at low tide.

This species appears very distinct, and by the ridges and markings on the body is easily distinguished from other New Zealand species. I have never seen more than the original specimen, and have therefore nothing to add to my original description.

IDOTEA METALLICA.

Idotea metallica, Bosc, "Hist. Nat. Crust.," ii., p. 179, pl. xv., fig. 6 (1802).

Idotea argentea, Miers, "Cat. N.Z. Crust.," p. 92 (1876).

Idotea metallica, Miers, "Jour. Linn. Soc. Zoology," xvi., p. 35 (1881); Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 155 (1886).

"This species is oblong-oval, moderately convex, the somewhat projecting epimera usually giving, in the adult, a serrated appearance to the sides of the thorax. The head is transverse, with the anterior margin slightly concave; the antero-lateral angles rounded, and but little prominent; near the posterior margin of the head is a deeply impressed arcuated transverse furrow. The surface of the body is more or less rugose; the lateral sutures on the dorsal surface of the postabdomen posterior to the second segment are strongly marked, nearly straight, and directed obliquely upward towards the middle line of the body; the terminal segment is convex, nearly oblong, rounded at the postero-lateral angles; posterior margin square-truncated or very slightly excavated, or with a very obscure median denticle. The eyes are large and prominent. The terminal joint of the peduncle of the antennæ longer than the preceding; the flagellum short, usually 7–10-jointed. The epimera are well developed, with the postero-lateral angles subacute and usually somewhat projecting in the adult; the basal plate of the opercular valves is oblong, with parallel sides; the terminal plate nearly square, but rounded off at its externo-distal angle."—[MIERS.]

Length, from 17mm. to 28mm. (Miers).

Of this species Miers says, "Apparently a very common and almost cosmopolitan species, probably occurring everywhere except in arctic and antarctic latitudes."

It was introduced originally into the New Zealand catalogue on the authority of Dana, who referred a specimen six lines

long, found *near New Zealand*, to his *Idotea argentea*, which Miers considers synonymous with *I. metallica*, Bosc.

A specimen undoubtedly belonging to this species was in the collection of Mr. R. Helms, which I examined in 1888. His specimen was certainly taken on the New Zealand coast, probably from Picton, Marlborough.

Idotea margaritacea, Dana, is considered by Miers as probably not distinct from *I. metallica*, though Dana "describes the front as three-toothed, the three teeth very low, one occupying either angle, and the third, which is less distinct, the middle of the front; the outer are subacute and the spaces between low-concave; the body is not quite as much narrowed behind, and the flagellum of the outer antennæ has but four or five joints."

It was captured between Australia and southern New Zealand, 500 miles from Port Jackson, so that it belongs to Australia rather than to New Zealand. It is introduced into the Australian catalogue by Haswell in his "Revision of the Australian *Isopoda*."*

Idotea lacustris.

Idotea lacustris, Thomson, "Trans. N.Z. Inst.," xi., p. 250 (1879); ? Miers, "Jour. Linn. Soc. Zoology," xvi., p. 39, pl. i., figs. 11 and 12 (1881); Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 156.

Body narrow elliptical, fairly convex, surface finely punctured. Head with front emarginate, antero-lateral lobes not very prominent, impressed line near posterior margin of the head distinctly marked. First thoracic segment slightly longer than the succeeding, with the antero-lateral angles produced into rounded lobes, those of other segments not produced; succeeding segments subequal in length. Post-abdomen not very convex, as long as the five preceding segments of thorax, composed of two short segments followed by a third bearing two sutures on each side, the posterior suture extending further to the centre than the anterior; end bluntly rounded, margin quite entire. Eyes rather large. Antennules reaching nearly to the end of the third joint of the peduncle of the antennæ, consisting of four joints, the first broad, the other three subequal in length but much narrower. Antennæ when retracted reaching to the posterior margin of the second segment of the thorax, about one-third the length of the body; flagellum as long as peduncle, bearing, *in the male*, a dense fringe of very short fine setæ. Epimera nearly rectangular, those of second to fourth segments reaching quite back to the postero-lateral angles of the segments, those of

* "Proc. Linn. Soc. N.S.W.," vol. ix., pt. 4.

fifth to seventh segments broader and with the postero-lateral angles slightly produced. Terminal plates of the operculum with the exterior margin regularly rounded, very finely serrate at the end. Colour, dark-grey. Length, 15mm.; breadth, 7mm.

In New Zealand this species has been found only in Tomahawk Lagoon (fresh water), near Dunedin, where it has been taken in considerable abundance. It appears to be identical with specimens, presumably marine, from the Straits of Magellan; but Miers gives the identification with much hesitation on account of the widely-remote locality at which they were obtained. Unfortunately Miers gives no description of these specimens, simply stating that they agree fairly well with Mr. Thomson's description of *I. lacustris*. However, the figure that he gives would answer very well for *I. lacustris*, except that it shows one pair of sutures on the last segment of the postabdomen instead of two; and, judging from the figure, I should say that the Magellan specimens do not differ specifically from *I. lacustris*. In any case the specimens from the two localities are very closely allied, and would appear to be the remnants of a species probably once abundant and widespread in the southern seas. In that case *I. lacustris* has probably been preserved in Tomahawk Lagoon owing to its isolation and freedom from competition with other species, which would appear to have supplanted it on the coasts of New Zealand elsewhere.

The "dense fringe of very short setæ" on the antennæ is found in the male only. There is no fringe on those specimens (nine in number) which I know to be females, while it is present in all the specimens (thirteen in number) which I know from other reasons to be males. In all of these it is associated with a similar fringe on the second pair of thoracic legs. In some specimens the fringe is not so well developed as in others, and it seems to be developed first on the antennæ and then on the second pair of legs, for in one or two specimens where there is only a slight indication of it on the antennæ there is none at all on the second pair of legs. In all probability these fringes are a secondary sexual character, not developed in the males till they are mature, or perhaps developed only during the breeding-season.

In the antennæ the fringe consists of exceedingly fine setæ densely packed, and when fully developed is found principally on the last joint of the peduncle, and on the 6–7 basal joints of the flagellum. In the second pair of legs the fringe is formed of setæ longer than those on the antennæ but of the same kind, and is developed on the inner (lower) surface of the ischios, meros, carpus, and propodos. The setæ forming

these fringes seem to be of the same character as those found on the propodos of the second gnathopod of the males of the Amphipods *Nicea fimbriata*, G. M. Thomson,* and *Elasmopus subcarinata* (= *Mæra subcarinata*, G. M. Thomson).†

In this species the males and females closely resemble one another in general shape of the body, and do not present the differences found in *I. elongata* and, to a much less extent, in *I. peronii*.

As I have already pointed out, this species is not so specialised as *I. elongata*, &c. In the opercular plates the second ramus is represented by a small membranous plate fringed with long plumose setæ, and the terminal plate also bears a few short setæ at the distal end.

In the brood-pouches of the females many young were found. All of these that I have examined resemble the adult animals, except that the seventh thoracic segment was small and without appendages.

Idotea ungulata.

Idotea ungulata, Miers, "Jour. Linn. Soc. Zoology," xvi., p. 52 (1881); Thomson, "N.Z. Jour. of Science," vol. i., p. 332 (1883); Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 156 (1886).

Idotea affinis, Miers, "Cat. N.Z. Crust.," p. 93 (1876); Thomson, "Trans. N.Z. Inst.," xi., p. 232 (1879).

Idotea excavata, Haswell, "Proc. Linn. Soc. N.S.W.," vol. vi., p. 2; "Cat. Australian Crust.," p. 277 (1882).

"Body oblong, moderately convex, and nearly smooth. Head with the frontal margin very slightly concave, but with a slight depression in the middle; antero-lateral angles usually but little prominent, smooth above, or with faint indications of an impressed curved line near the posterior margin. Segments of the thorax smooth; the first the shortest, its antero-lateral processes obtuse; the postero-lateral angles of the first to third segments rounded, of the fourth to seventh segments rectangular or acute. Postabdomen somewhat depressed towards its distal extremity, smooth, with lateral sutures indicative of two coalescent segments; terminal segment with the lateral margins straight to within a short distance of the postero-lateral angles, which are either obtuse or acute; distal end emarginate. Eyes small, black. Antennules not reaching to the distal end of the penultimate joint of the peduncle of the antennæ. Antennæ when retracted not reaching to the posterior margin of the fourth thoracic segment, and often much shorter; last two joints of the peduncle short and subequal; flagellum

* See "Trans. N.Z. Inst.," xi., p. 236.

† See "Annals and Mag. Nat. Hist.," ser. 5, vol. xvi., p. 368.

longer than the peduncle, with 12 to 28 joints. Epimera rather narrow, in the second and third thoracic segments scarcely occupying more than half the length of the lateral margins, in the fourth to seventh segments occupying their whole length; only the last two epimera on each side have their postero-lateral angles acute. The legs are robust; the fourth to seventh pairs of legs have their posterior and outer angles of the meros and ischium produced, and in adult examples spiniform. The posterior plates of the opercular valves are quadrate and nearly square. The length of the largest example in the Museum collection exceeds 2¼in. (58mm.), but average-sized examples measure about 1¾in. (45mm.)."—[MIERS.]

All the specimens that I have collected have been green in colour, and were found on green seaweed.

In this species the female, when bearing eggs in the brood-pouch, has the thorax from the first to the fourth segments more or less expanded, as in *Idotea peronii*.

This is the commonest species of *Idotea* in New Zealand, and is widely distributed in the southern seas, being found in the Indian Ocean, in Australia, on the east and west coasts of South America, Falkland Islands, Cape of Good Hope, &c.

As stated by Miers, there is "considerable variation in the length of the flagella of the antennæ, the robustness of the legs, and the depth of the posterior notch of the terminal segment and the acuteness of its postero-lateral angles." From the account of *Idotea excavata*, Haswell, given below, it will be seen that, if this species is identical with *I. ungulata*, there is also some variation in the amount of coalescence of the postabdominal segments, as there is also in *Idotea peronii* and *I. elongata*. Miers has already suggested that *Idotea excavata*, Haswell, is probably identical with *I. ungulata*,* and, accepting this suggestion, Haswell has struck out *I. excavata* from the list of Australian *Idoteidæ*, though he omitted to put *I. ungulata* in its place.† Through the kindness of the Trustees of the Australian Museum, I have been able to obtain specimens of *I. excavata* from Portland, Victoria, and to compare them with New Zealand specimens. Both specimens are small, the largest being 20mm. in length. The abdomen consists of a single segment only, scarcely a trace even of a suture being discernible. They thus differ in a marked degree from New Zealand specimens; but, in view of the variation in this respect that I show exists in *I. elongata* and *I. peronii*, I am not disposed to place very much importance on this

* "Zoology of the 'Alert,'" p. 311, footnote.

† "Revision of the Australian Isopoda," "Proc. Linn. Soc. N.S.W.," vol. ix., part 4.

difference. The epimera, again, though of the same shape as in *I. ungulata*, are more or less anchylosed to their respective segments, especially in the second, third, and fourth segments, where the dividing-mark is difficult to be seen; in the fifth, sixth, and seventh segments the epimera are anchylosed anteriorly, but free behind. The segments are somewhat separated at the sides, so that the lateral borders are not so continuous as in New Zealand specimens of *I. ungulata*; the terminal notch is deeper, and the postero-lateral angles more rounded and produced. Altogether, the differences between the specimens are pretty considerable; but, taking into consideration the variation known to exist on these points in this and other species, I am inclined to follow Miers in combining the two species. In all respects except those mentioned the resemblance is very close.

It will be seen that in the coalescence of the epimera with their segments, and of the segments of the postabdomen, and in the rounded postero-lateral angles, the Australian specimens resemble *I. elongata*, and tend to connect that species with *I. ungulata*.

Idotea elongata.

Idotea elongata, Miers, "Jour. Linn. Soc.," xvi., p. 54 (1881); "Cat. N.Z. Crust.," p. 93, pl. ii., fig. 3 (1876): Chilton, "N.Z. Journal of Science," vol. i., p. 517 (1883): Thomson, "N.Z. Journal of Science," vol. i., p. 332 (1883): Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 156 (1886).

♀ *Edotia dilatata*, Thomson, "Trans. N.Z. Inst.," xvi., p. 235, pl. xii. (1884); Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 156 (1886).

"Body elongate, almost linear, smooth, with the dorsal surface very convex, so that the animal appears almost cylindrical in a dorsal view. Head with the anterior margin scarcely excavated, but with a slight depression in the middle between the antennules; antero-lateral angles not prominent. Segments of the thorax (in the adult male) usually longer than broad, first segment with the antero-lateral lobes prominent and obliquely truncated. Postabdomen about equalling the $3\frac{1}{2}$ posterior thoracic segments in length, having usually indications of a lateral suture on each side at some distance from the base of the terminal segment, which is rather depressed above, with subparallel sides, rounded postero-lateral lobes, and a moderately deep rounded notch at its distal end. Eyes small. Antennules scarcely reaching to the distal end of the antepenultimate joint of the antennæ, which have a short peduncle, the last two joints of which are subequal, and each but little longer than the antepenultimate joint; flagellum 18–22-jointed; when retracted the antennæ do not reach

beyond the posterior margin of the fourth thoracic segment. Legs very slender. Epimera scarcely visible in a dorsal view; in a lateral view they are narrow, linear, and the last pair only reach to the postero-lateral angles of the segment with which they are articulated. Terminal plates of the opercular valves somewhat longer than broad, four-sided, with the distal ends truncated or very slightly emarginated. Length of a full-sized male about 2in. (50mm.); breadth about ¼in. (7mm)."—[MIERS.]

All the specimens that I have seen were brown in colour when alive, and were found on brown seaweeds.

My specimens, of which I have a fair number from Lyttelton, Akaroa, and Brighton near Dunedin, agree well with Miers's description as given above. In some specimens the postabdomen is almost uniarticulate, the dividing-mark being very indistinct; the epimera are difficult to make out, and are usually more or less completely anchylosed with their respective segments. In the female, which has been described as *Edotia dilatata* by Mr. Thomson, the thorax is "much dilated in the middle, the second, third, and fourth segments being progressively broader and bluntly angled at the sides, fifth suddenly narrowing to less than half the width of the fourth." In the adult female the plates forming the broad pouch arise from the second, third, fourth, and fifth segments of the thorax. I have one specimen, apparently a young female, with plates of fairly large size on the fifth segment, and very slight indications of plates on the second, third, and fourth; and in this specimen the thorax is slightly broadened.

The depth of the notch at the end of the postabdomen varies to some extent. Miers describes it as "a moderately deep rounded notch;" in many of my specimens it might be called a "shallow notch;" but, again, in Mr. Thomson's type-specimen of *Edotia dilatata* the notch is deeper: the postero-lateral angles are rounded; in Mr. Thomson's figure* they are shown rather more acutely than they should be.

IDOTEA PERONII.

Idotea peronii, M.-Edw., "Hist. Nat. Crust.," iii., p. 133 (1840); Miers, "Jour. Linn. Soc. Zoology," xvi., p. 55, pl. ii., figs. 6 and 7 (1881).

Idotea stricta, Dana, "U.S. Expl. Exped.," xiv., Cr. ii., p. 704, pl. xlvi., fig. 7 (1853); Miers, "Jour. Linn. Soc. Zoology," xvi., p. 62 (1881).

Idotea caudacuta, Haswell, "Proc. Linn. Soc. N.S.W.," vi., p. 1, pl. iv., fig 4.; "Cat. Aust. Crust.," p. 276 (1882).

"Body narrow-oblong rather than oval, not carinated,

* *Loc. cit.*, pl. xii., fig. 9.

nearly smooth. Head emarginate anteriorly, the middle of the notch straight; the antero-lateral angles rather prominent and rounded. First thoracic segment with the antero-lateral lobes rather broad, and not reaching nearly to the eyes. Postabdomen as long as the four or five posterior thoracic segments; terminal segment with two small sutures on each side near the base (indicative of coalescent segments), and with subparallel sides, distal end usually broadly triangulate, and apex subacute. Eyes of moderate size. Antennules scarcely reaching to the base of the antepenultimate joint of the peduncle of the antennæ, with their basal joints considerably dilated. Antennæ with the joints of the peduncle short, the last two subequal, and each but little longer than the antepenultimate joint; flagellum 16–21-jointed, and longer than the peduncle. The epimera are narrow, and in the second, third, and fourth thoracic segments scarcely occupy more than half of the lateral margins; in the fifth segment they reach nearly, and in the sixth and seventh segments quite, to the postero-lateral angles, and in these segments are of a more or less triangulate shape. The legs are very slender. The terminal plates of the opercular valves are three-sided, with their outer margins curving to the distal extremity, which is subacute or blunt. Length of the largest male, about $1\frac{7}{8}$in. (48mm.); breadth, nearly $\frac{5}{12}$in. (10mm.); but most of the specimens are much smaller."—[MIERS.]

In Miers's "Revision of the *Idoteidæ*," this species is recorded from various parts of Australia, but it has not hitherto been recorded from New Zealand. I first recognised it from a specimen sent me from Lyttelton Harbour by Mr. R. M. Laing; there is a specimen in the Dunedin University Museum from Cape Campbell; and in Mr. Thomson's collection there were two specimens from Waipapa Point, collected by Mr. J. F. Erecson, and a small specimen from Moeraki, collected by Professor Parker. On several occasions I have picked up fragments of this species which had been washed up on the Ocean Beach, Dunedin. These fragments consisted of the skeleton of the postabdomen and one or two posterior segments of the thorax. Curiously enough, I could find no trace of the head and anterior segments of the thorax, though at the same time and at the same place I gathered fragments consisting of the head and anterior segments of the thorax of *Pseudæga punctata*, Thomson, but could not find any trace of the hinder parts of the body of this species. My fragments of *Idotea peronii* when gathered were light reddish-pink in colour, but whether this had been the colour of the animals when alive I cannot say; the other specimens, from Lyttelton, &c., are in spirit greyish, sometimes closely covered with small dark spots.

Since this was written I have taken several specimens of this species in rock-pools at Brighton, near Dunedin. They were all taken on red seaweeds, and they closely resembled the seaweed in colour, some of them also having a narrow white streak of varying width down the middle of the back. It is worthy of note that our three commonest species of *Idotea* are usually found on differently-coloured seaweeds which they closely resemble in colour: *Idotea ungulata* on green, *I. elongata* on brown, and *I. peronii* on red.

In his "Revision of the *Idoteidæ*" Miers refers to the resemblance between *Idotea peronii*, M.-Edw., and *I. stricta*, Dana, but does not unite them because of the uniarticulate postabdomen of *I. stricta*. It appears, as I shall proceed to show, that this character is subject to variation, and I have therefore united the two species. The conclusion that they both belong to the same species is to some extent confirmed by the fact that, while I had labelled my specimens *I. peronii*, those in Mr. Thomson's collection, which closely resemble mine, had been labelled by that gentleman as *I. stricta*. All the New Zealand specimens that I have examined resemble *I. stricta* in having the postabdomen uniarticulate, but, unlike that species, they have *three* sutures at the sides; the marks from the first suture, indicating the coalescence of the segments, can be traced further across the postabdomen than those from the second and third sutures, and in some are very faintly indicated almost right across, thus representing the two segments as in *I. peronii*. Hence they may be considered to be specimens of *I. peronii* in which the *two* segments of the postabdomen have more or less completely coalesced. *I. stricta* is described and figured by Dana as having a uniarticulate postabdomen, with only *one* suture on each side, so that the difference of the number of sutures remains to be accounted for: however, as M.-Edwards has described *one* lateral suture on the terminal segment of the postabdomen of the type-specimen of his *I. peronii*, while, according to Miers, there are really *two* present,* it seemed very probable that the sutures vary in distinctness, and that in the specimens examined by Dana the second and third were so indistinct that they were not observed by him; and this view is fully confirmed by an examination of specimens of *I. caudacuta*, Haswell, kindly forwarded to me by the Trustees of the Australian Museum, Sydney.

In the "Zoology of the 'Alert,'"† Miers has already suggested that *I. caudacuta*, Haswell, is probably identical with *I. peronii*, M.-Edwards, and before noticing Mr. Miers's

* "Jour. Linn. Soc. Zoology," xvi., p. 56.

† P. 311, footnote.

suggestion I had come to the same conclusion from a comparison of the descriptions of the two species. In his "Revision of the Australian *Isopoda*,"* Mr. Haswell, adopting Miers's suggestion, omitted *I. caudacuta* from the list without comment. I have now been able to examine specimens of *I. caudacuta*, Hasw., from Warrnambool, Victoria, and to compare them with my New Zealand specimens of *I. peronii*, M.-Edw. The result fully proves the truth of Mr. Miers's suggestion, while, as I have already hinted, the specimens present certain features which still further connect *I. peronii* and *I. stricta*. In the specimens from Warrnambool the body is rather more convex and somewhat narrower than in my New Zealand specimen of *I. peronii*, especially in the postabdomen, and the lateral margins are rounded instead of thinning out, and form a more or less distinct edge. The postabdomen consists of two segments, but, although the division-line is traceable right across with a little difficulty, the two segments are firmly anchylosed together, and the two sutures on the second segment are very indistinct, the first one especially so. The facts already stated show that there is considerable variation in the distinctness of the division-marks on the postabdomen, and there is therefore no difficulty whatever in seeing that Dana's description of *I. stricta*, as possessing a uniarticulate postabdomen with a single suture on each side, was taken from a specimen in which the division-marks were a little more indistinct than in the Warrnambool specimens. It is perhaps worthy of note that, while in these specimens the postabdomen is composed of two segments, and the following two pairs of sutures are very indistinct, in the New Zealand specimens there is only one segment to the postabdomen, but all three sutures are clearly marked.

One of the specimens from Warrnambool is a female bearing eggs in the brood-pouch, and this specimen has the thorax somewhat expanded, though not to anything like the same extent as in *Idotea elongata;* the length is 22·5mm., and the greatest breadth is about 6·5mm. One of the specimens in Mr. Thomson's collection, again, is a female bearing eggs, and in this specimen also there is a slight widening of the thorax; the length is 25mm. and the greatest breadth 7·5mm. In specimens not bearing eggs the proportionate breadth is slightly less than this: thus, one specimen has—length 27·5mm., breadth 7·5mm.; another, length 22·5mm., breadth 6mm.; a third, length 16mm., breadth 4mm.

The specimen in Mr. Thomson's collection from Moeraki is a young one, only 5mm. long. The front margin of the head is not emarginate, being even very slightly convex in the

* "Proc. Linn. Soc. N.S.W.," vol. ix., part 4.

centre;* the seventh segment of the thorax is small, only about half as long as the sixth, and bears no appendages; the three sutures on the postabdomen are clearly marked, the first extending further across the body than the other two; the epimera of the fifth and sixth segments only are visible in dorsal view, and these are small, and the flagellum of the antenna is represented by one joint equal in length to the last joint of the peduncle, and followed by a minute second joint.

CLEANTIS TUBICOLA.

Cleantis tubicola, Thomson, "N.Z. Jour. of Science," ii., p. 577 (1885); Thomson and Chilton, "Trans. N.Z. Inst.," xviii., p. 156 (1886); Thomson, "Trans. N.Z. Inst.," xxi., p. 264, pl. xiv., figs. 5–8 (1888).

Body narrow, much elongated, with the sides perfectly parallel. Head with its lateral margin produced downwards into an angular lobe, its front margin nearly straight, its posterior margin produced backwards in the middle into an excavation of the first thoracic segment. First thoracic segment subequal in length to the head, antero-lateral angles slightly produced forward; second segment rather shorter; succeeding segments subequal, hardly exceeding the first in length. The postabdomen nearly equal in length to the five preceding segments of the thorax, apparently consisting of two short segments, the second of which is indistinctly marked and has the posterior margin emarginate, followed by the long third segment, which bears two indistinct sutures on each side; sides parallel except towards the end, where they curve inwards to the extremity, which ends in a deep semicircular notch. Eyes narrow, transverse, placed near the antero-lateral angles of the head. Antennules reaching to the end of the third joint of the peduncle of the antennæ, peduncle three-jointed, flagellum of one long joint, ending in a very short joint and a tuft of setæ; antennæ thick and pediform, as long as the head and first three segments of the thorax; peduncle five-jointed, the first very short, and concealed in dorsal view by the head, the remaining four subequal in length, the flagellum apparently represented by a single tapering joint about equal to the last joint of the peduncle. The legs short and somewhat compressed, first broader and shorter than the second and third, the third rather longer and more slender than the second, the fourth much shorter than the third and placed transversely, the three last pairs increasing in length posteriorly. Epimera of second to fourth segments indistinct, those of fifth and seventh segments distinct and with the ex-

* Compare Miers, "Revision of the *Idoteidæ*," "Jour. Linn. Soc.," xvi., pp. 56, 57.

terior margins produced backwards. The terminal plate of the operculum triangular, about one-third the length of the basal plate. Colour brown, with minute black punctations. Length 15mm. (thorax 11mm., postabdomen 4mm.), the ratio of the length to the breadth being as 11 to 1.

Hab. Auckland; found in a tube.

The tube in which this animal was found is about ½in. long, and appears to be part of the hollow stem of some plant. Whether the presence of the animal in this tube is accidental or habitual is uncertain, but the short legs and strong antennæ seem to favour the latter supposition.

The description given above is mainly taken from Mr. Thomson's description, but I have rearranged it and added to it to some extent. He describes *four* joints in the peduncle and *two* in the flagellum of the antennæ. In the peduncle there seem to be *five* joints, but the first is very short, as it usually is in the *Idoteidæ*, and hidden in a dorsal view by the head. In the flagellum I can only make out a single joint—a flagellum of a single joint is, in fact, given as one of the generic characters of *Cleantis*.

Judging from the description this species is very close to *Cleantis granulosa*, Heller, from St. Paul's, but from a tracing of Heller's figure in "Reise der Novara," pl. xii., fig. 2, kindly made for me by Mr. R. M. Laing, it is evident that the legs in that species are much longer than in *C. tubicola*.

Art. XXIII.—*Descriptions of New Zealand* Lepidoptera.

By E. Meyrick, B.A., F.E.S.

[*Read before the Philosophical Institute of Canterbury, 7th November, 1889.*]

I give here descriptions of the whole of the New Zealand species of the three following groups: viz, *Bombycina*, *Sphingina*, and *Hypsina*. They are remarkable for their very small number, and for the absence of any specially characteristic or peculiar forms. They prove with certainty that the New Zealand fauna of these three groups is entirely of comparatively recent growth, and is also of solely Australian origin. Considering the powerful flight of many species in these groups, and their relative abundance in Australia, it is perhaps a matter for surprise that a larger number have not found their way across. One Australian species which I have not included hereafter—*Cossus lituratus*, a large insect, of which the larva feeds in the trunk of trees—was once taken by

Mr. Fereday, but under circumstances which left no doubt that it had recently emerged from imported timber; it is not, therefore, entitled to a place in the list. The corresponding Australian list numbers probably about eight hundred species, against which New Zealand is at present unable to furnish twenty, nor is it probable that more than some half-dozen others remain to be discovered.

BOMBYCINA.

HEPIALIDÆ.

Ocelli absent. Tongue generally obsolete. Antennæ less than half forewings. No maxillary palpi. Tibiæ without spurs. Forewings with all main veins and costa connected by crossbars near base; 1 furcate towards base (the furcation appearing as a parallel vein connected by terminal bar), 9 and 10 stalked, 11 from near base, forked parting-vein well defined. Hindwings without frenulum; 1c present; neuration essentially identical with that of forewings.

A curious family of very ancient development; it is of very general distribution, not very largely developed anywhere, but perhaps most in Australia. The New Zealand genera are characteristically Australian. This is the only family of the group which is represented by a fair number of species, all or nearly all being endemic; and it is therefore probable that their ancestors were the first to gain a footing in the country, and that they were specially favoured in meeting with suitable food. The larvæ of the family feed usually on the roots of grass, less commonly in the wood or on the roots of trees; and, whilst it seems to me that the forests in New Zealand are of comparatively recent date, there can be no question that grass-feeding insects have always found abundant room. To this fact, rather than to the undoubtedly real antiquity of the family, I attribute its greater development.

The two genera may be distinguished by the structure of vein 8. Besides the species given, *Pielus ingens*, Walk., a very large unicolorous brownish-ochreous or reddish insect, has been stated to occur; but I believe the record to be erroneous: it is certainly Australian, and I have never met with a really authentic New Zealand specimen. At the same time, I must admit having been unable to learn to what species the so-called "vegetable caterpillar" (infested with the *Sphæria* fungus) is referable, except that it is a large brown species of this family. It was formerly attributed to *Hepialus virescens*, but this was certainly erroneous, as the larva of that species lives in the stems of trees, and never goes beneath ground even to pupate, whilst the larva in question is subterranean. It ought to be easy for local collectors possessed of a little perseverance to clear up this difficulty.

1. Porina, Walk.

Antennæ $\frac{1}{4}$–$\frac{2}{5}$, in ♂ bipectinated, or more or less shortly bidentate. Palpi moderate, porrected, basal joint rough-haired, second joint rough-haired or almost smooth, terminal joint smooth, sometimes subclavate. Posterior tibiæ densely rough-haired. Forewings with vein 7 from angle of cell, 8 and 9 out of 10, rising from upper margin much before angle. Hindwings as in forewings.

The difference in the structure of the antennæ does not here justify generic division: every gradation is found in the Australian species between strong pectination and almost imperceptible dentation, and no line can be drawn. In all the species the forewings are elongate-triangular, with costa somewhat sinuate, apex rounded-obtuse, hindmargin very obliquely rounded, continuous with inner margin; the hindwings formed as the forewings, but less elongate. The species are troublesome to distinguish, owing to their great variability of marking and colour, and some are imperfectly known to me. The following tabulation may therefore be found not entirely accurate:—

1. Forewings with a conspicuous pale streak above inner margin	3. *enysii.*
Forewings without a conspicuous pale streak above inner margin	2.
2. Forewings with oblique, diverging, blackish discal bars	2. *mairi.*
Forewings without oblique, diverging, blackish discal bars	3.
3. Forewings with conspicuous blackish spot above middle of inner margin	4. *characterifera.*
Forewings without conspicuous blackish spot above middle of inner margin ..	4.
4. Antennæ of ♂ strongly pectinated ..	1. *dinodes.*
Antennæ of ♂ bidentate	5.
5. Cilia of hindwings ochreous, unicolorous	6.
Cilia of hindwings dark fuscous or barred with dark fuscous	7.
6. Central white streak of forewings almost straight	7. *umbraculata.*
Central white streak of forewings irregular or broken into uneven spots	8. *signata.*
7. Discal white spots of forewings simple ..	6. *despecta.*
Discal white spots of forewings composed of about three confluent spots	5. *cervinata.*

1. *Por. dinodes*, n. sp.

♂. 59mm. Head whitish-ochreous, face and palpi fuscous. Antennæ ferruginous, strongly bipectinated. Thorax fuscous, with small whitish central spot. Abdomen and legs greyish-ochreous. Forewings fuscous, somewhat ochreous-tinged; numerous irregular well-defined crescentic white marks; on dorsal half these are placed to margin four transverse series of

roundish fuscous spots becoming obsolete on costal half, except fourth which runs to apex, first two much confused; a double submarginal series of irregular similar marks; cilia white, barred with dark fuscous. Hindwings light brownish-ochreous; cilia white, barred with fuscous.

Invercargill; two specimens (coll. Fereday), taken by Captain Hutton. Nearest to some Australian forms, as *fusco-maculata;* excluding the two following species, of which the antennæ in the ♂ are unknown to me, this species differs from all the other five by the strongly-pectinated antennæ.

2. *Por. mairi*, Buller.

(*Porina mairi*, Buller, "Trans. N.Z. Inst.," 1872, 279, pl. xvii.)

130mm. Forewings light brownish-ochreous; a whitish-ochreous blotch towards middle of inner margin, partly suffusedly margined with dark fuscous; a blackish mark in disc towards base; two oblique diverging blackish marks in disc before middle, margined with whitish; a triangular white spot below cell, and a white patch beyond it; three blackish transverse lines beyond cell, reaching below middle of wing, with brown interspaces; a posterior series of rounded dark spots circled with whitish; a submarginal series of wedge-shaped blackish spots; a hindmarginal series of black spots, preceded by a waved whitish line. Hindwings fuscous-grey, more brownish posteriorly, with eight interrupted blackish transverse lines.

North Island, in forest. I have not seen a specimen of this species, and have drawn the preceding description from a comparison of the original description and figure; nor can I speak positively as to the generic position, since no structural characters are given; but, if there is no error, the species must be very easily recognisable from all others of this genus by its very much greater size.

3. *Por. enysii*, Butl.

(*Porina enysii*, Butl., "Proc. Zool. Soc. Lond.," 1877, 381, pl. xlii., 7.)

♂ ♀. 52–62mm. Forewings ochreous-brown, more or less mixed and marbled with dark fuscous or black; an ochreous-white irregular streak from base to inner margin at $\frac{3}{4}$, partially margined with darker suffusion, sometimes widened above to form a whitish-ochreous band extending to anal angle. Hindwings yellow-ochreous.

North Island. I have seen only the type in the British Museum and a specimen in Mr. Fereday's collection, both badly damaged. I have not been able to determine properly the generic position, and the above description is merely a rough diagnosis, but the species appears distinct, and it would be useless to attempt more from such poor material.

4. *Por. characterifera*, Walk.

(*Hepialus characterifer*, Walk., "Suppl.," 594; *Oxycanus impletus*, ib., 598.)

♂ ♀. 68–80mm. Head and thorax brownish-ochreous; antennæ of ♂ shortly bidentate. Forewings yellow-ochreous, closely marbled with blackish; two or three irregular posterior series of very small subtriangular blackish white-centred marks; several small dark fuscous spots towards base; a moderate subtriangular conspicuous blackish-fuscous spot above middle of inner margin. Hindwings dark fuscous-grey, sometimes with one or two posterior series of pale rings; cilia yellow-ochreous barred with dark grey.

Auckland; two specimens (Brit. Mus. Coll.). Easily known by the characteristic blackish spot towards middle of inner margin.

5. *Por. cervinata*, Walk.

(*Elhamma cervinata*, Walk., "Suppl.," 595; *Porina vexata*, ib., 597; *Pielus variolaris*, Gn., "Ent. Mo. Mag.," v. 1; *Porina fuliginea*, Butl., "Cist. Ent." ii., 488.)

♂ ♀. 34–40mm. Head, thorax, and abdomen brownish-ochreous. Antennæ fuscous, in ♂ bidentate. Forewings yellowish-ochreous or fuscous; a small round white black-margined spot in disc at $\frac{1}{8}$; two or three irregular somewhat larger spots confluent in disc at about $\frac{1}{4}$; two or three others united to form an oblique transverse mark in middle; sometimes another between these and the preceding; the whole of these connected by a broad cloudy darker streak, sometimes mixed with black; two white black-circled dots below disc at $\frac{1}{4}$; three transverse more or less visible series of triangular white black-margined dots, first beyond middle, first two terminating in small black spots on inner margin, third more or less confluent into a connected line; between second and third a cloudy darker shade, sometimes mixed with black; sometimes a hindmarginal series of black dots; in specimens with fuscous ground-colour many of these markings tend to be obscured: cilia whitish-ochreous, more or less distinctly barred with dark fuscous, or almost wholly dark fuscous. Hindwings yellowish-ochreous, greyish-tinged in disc, sometimes partially or wholly suffused with dark grey or fuscous; sometimes an indistinct subterminal series of dark fuscous spots; a hind-marginal series of blackish dots; cilia as in forewings.

Auckland to Dunedin; common. Very variable: northern specimens are more yellow-ochreous, and more distinctly spotted, and they become more fuscous in proportion as they are further south; Dunedin specimens are constantly fuscous, but there appears to be a complete gradation between the forms. The ochreous forms are easily distinguished from other species by the numerous spots, and the absence of a continuous

pale discal streak; the fuscous forms are sometimes very similar in colouring to *P. despecta*, but they are distinctly shorter-winged, and the compound discal spots appear to be a good persistent character.

6. *Por. despecta*, Walk.

(*Hepialus despectus*, Walk., "Suppl.," 594.)

♂ ♀. 41–50mm. Head, thorax, and abdomen fuscous, anal tuft ochreous-whitish. Antennæ fuscous, in ♂ bidentate. Forewings fuscous; a small white dark-margined wedge-shaped spot in disc at $\frac{1}{4}$, and a larger one in middle, sometimes with traces of a cloudy darker fuscous connecting streak extending from base to $\frac{3}{5}$; the second white spot sometimes sends a short projection upwards; sometimes a pale whitish-fuscous narrow transverse band at $\frac{4}{5}$, marked with a more or less complete double series of fuscous marks, but this often very faint or obsolete; sometimes traces of a series of pale rings beyond this, and two or three more above second discal spot, often absent: cilia rather darker fuscous, tips ochreous-whitish barred with dark fuscous. Hindwings light fuscous; cilia as in forewings.

Christchurch, Otira River, Lake Wakatipu; common. Longer-winged than the preceding (the ♀ is also longer-winged than the ♂), and characterized by its uniform fuscous colour and simple marking.

7. *Por. umbraculata*, Gn.

(*Pielus umbraculatus*, Gn., "Ent. Mo. Mag.," v., 1.)

♂ 37–41mm., ♀ 43–53mm. Head and thorax light yellowish-ochreous, sometimes fuscous-tinged. Antennæ ochreous, in ♂ bidentate. Abdomen light yellowish-ochreous. Forewings light yellowish-ochreous, more or less partially fuscous-tinged; costa sometimes narrowly fuscous; a nearly straight slender white central longitudinal streak from about $\frac{1}{6}$ to $\frac{4}{5}$, attenuated to both extremities, interrupted beyond middle, posterior portion sometimes much reduced, the whole margined above slenderly with dark fuscous, and beneath by a moderate dark-fuscous suffusion extending in ♂ almost to base of wing, in ♀ less marked; generally four or five small dark fuscous linear dots, centred with one or two white scales, between posterior extremity of central streak and costa, and two or three more towards inner margin, all tending to be obsolete; sometimes a series of small dark fuscous dots on hindmargin, and an indistinct fuscous hindmarginal line: cilia whitish-ochreous. Hindwings in ♂ yellow-ochreous, in ♀ paler and becoming pale greyish posteriorly; an indistinct fuscous hindmarginal line; cilia whitish-ochreous.

Wellington and Christchurch; common. Sufficiently well distinguished by the straight white median streak.

8. *Por. signata*, Walk.

(*Elhamma signata*, Walk., "Bomb.," 1563; *Porina novæ-zealandiæ*, ib., 1573.)

♂ ♀. 49–58mm. Head and thorax rather deep ochreous or fuscous. Antennæ yellowish-ochreous, in ♂ bidentate. Abdomen yellowish-ochreous, slightly reddish-tinged, posteriorly sometimes fuscous-tinged. Forewings yellowish-ochreous, somewhat reddish, or ochreous-fuscous; costal edge suffusedly dark-fuscous; a short cloudy whitish streak from base beneath costa, margined beneath with dark fuscous; a cloudy dark fuscous streak proceeding from this to disc at $\frac{2}{3}$, marked on its upper edge with two short longitudinal white streaks, first about $\frac{1}{4}$, second in middle, anterior extremity of second produced as a slightly-curved short white dark-margined streak obliquely upwards; sometimes these three connected into a continuous angularly-sinuate streak; several very small whitish subtriangular marks, margined with dark fuscous, irregularly placed towards costa about $\frac{3}{4}$, sometimes increased and enlarged to form a transverse series of short irregular longitudinal white streaks, and others towards anterior half of inner margin; a pale suffusion in disc beyond middle; a cloudy fuscous transverse shade about $\frac{3}{4}$; a more or less obscure transverse series of whitish dots, connected by a fuscous line, between this and hindmargin; a hindmarginal series of dark-fuscous dots: cilia fuscous, sometimes barred with whitish-ochreous. Hindwings yellow-ochreous, sometimes reddish-tinged; a fuscous hindmarginal line; cilia whitish-ochreous.

Napier, Palmerston, and Wellington; common. Varies extremely in marking, but the discal streak appears never to become straight, preserving the irregular shape of the spots of which it is composed.

2. Hepialus, F.

Antennæ $\frac{1}{4}$–$\frac{1}{8}$, in ♂ simple. Palpi short or moderate, porrected, with rough projecting hairs, terminal joint naked, subclavate. Posterior tibiæ densely rough-haired, sometimes with long projecting tuft above in ♂. Forewings with vein 7 from angle of cell, 8 from upper margin much before angle, 9 and 10 stalked from near 8. Hindwings as in forewings.

The genus is nearly cosmopolitan. The Australasian species are all more or less green, and these have commonly been regarded as a separate genus, under the name of *Charagia*, but I am unable to discover any structural distinction. The sexes differ in marking and colour, sometimes to an extraordinary degree. The larvæ of the Australasian species live in galleries in solid wood, but their natural food appears rather to be the bark, which they devour sometimes for a con-

siderable distance round the mouth of the gallery, protecting themselves meanwhile beneath a shelter of silk and refuse.

9. *Hep. virescens*, Dbld.

(*Hepialus virescens*, Dbld., "Dieff. New Zeal.," ii., 284: White, "Tayl. New Zeal.," pl. i., 6: *Hepialus rubroviridans*, White, *l.c.*, pl. i., 1: *Charagia virescens*, Walk., "Bomb.," 1569; Scott, "Trans. Ent. Soc. N.S. Wales," ii., 28: *C. fischeri*, Feld., pl. lxxx., 1: *C. hectori*, Butl., "Proc. Zool. Soc. Lond.," 1877, 380.)

♂. 86–96mm. Head green. Antennæ yellow-ochreous. Thorax green, posterior extremity becoming whitish-ochreous. Abdomen whitish-ochreous, towards middle greenish-tinged. Forewings somewhat elongate-triangular, costa sinuate, apex round-pointed, hindmargin oblique, rather strongly sinuate inwards on upper half, rounded beneath continuously with inner margin; bright green, with irregular transverse series of partially confluent paler rings; two or three of these sometimes become whitish towards inner margin; a nearly straight series of about six rather cloudy white transverse marks, interrupted in middle, from beneath $\frac{3}{4}$ of costa to above $\frac{2}{3}$ of inner margin: cilia green. Hindwings whitish, more or less tinged with green towards hindmargin; and more broadly and strongly towards anal angle.

♀. 100–140mm. Forewings green, with obscure transverse darker marks; four or five quadrate fuscous spots on costa between base and $\frac{2}{3}$; two series of reddish-fuscous sometimes double or triple transverse marks parallel to hindmargin, sometimes including whitish spots, first at $\frac{2}{3}$, second at $\frac{5}{6}$; a narrow reddish-fuscous streak along inner margin; a hindmarginal series of reddish-fuscous marks. Hindwings red, apex green.

Auckland to Wellington; probably generally distributed in the North Island. The larva feeds in the stem and branches of *Melicytus* and other trees. This species has been stated to occur in Australia, but it seems certain that this was an error, founded on confusion with one of the larger Australian species.

PSYCHIDÆ.

No tongue. No maxillary palpi. Antennæ short, in ♂ bipectinated. Forewings with vein 1 furcate, posteriorly coalescing with veinlike submedian fold, 8 and 9 stalked. Hindwings with frenulum developed, 1c present, 8 connected by bar with 7, with one or more additional veins rising from it. Female apterous.

The larvæ live in portable cases, constructed of silk, and usually covered with pieces of stick or refuse; they are polyphagous, feeding indiscriminately on various trees and plants. The two New Zealand species are endemic, but have considerable relationship to ordinary Australian forms.

The two genera are best distinguished by the character of the additional veins rising from vein 8 of the hindwings.

3. Œcεticus, Guild.

Ocelli present. Antennæ ⅓, in ♂ strongly bipectinated, much more shortly on apical half. Labial palpi extremely short, rough-haired. Abdomen in ♂ very elongate, roughly hairy. Legs hairy, tibiæ without spurs, posterior tarsi extremely short and stout. Forewings with veins 4 and 5 short-stalked, 7 sometimes out of 9, 8 and 9 stalked, forked parting-vein well defined. Hindwings with veins 4 and 5 stalked, forked parting-vein well defined, 8 connected by bar with cell beyond middle, an additional vein (9) rising from 8 beyond bar, another (10) from 8 before bar, and another (11) from base of costa running into 8 before 10.

This generic name was wrongly spelt *Oiketicus* by its originator and others, for which there is no possible justification. I have corrected it.

10. *Œc. omnivorus*, Fdy.

(*Liothula omnivora*, Fdy., "Trans. N.Z. Inst.," 1877, 260, pl. ix.)

♂. 34mm. Head, antennæ, thorax, abdomen, and legs dark fuscous. Forewings very elongate-triangular, costa hardly arched, apex rounded, hindmargin rounded, rather strongly oblique; thinly scaled, dark fuscous. Hindwings ovate-triangular, thinly scaled, dark fuscous, more thinly and semi-transparent towards base, veins naked.

Christchurch, in September and October. The larva constructs a smooth case, without sticks, and feeds on various plants.

4. Orophora, Fdy.

Ocelli present. Antennæ ⅗, in ♂ moderately bipectinated throughout. Labial palpi rudimentary, hairy. Abdomen densely hairy. Forewings with veins 4 and 5 short-stalked, 7 and 8 out of 9. Hindwings with veins 4 and 5 stalked, parting-vein well defined, 8 connected by bar with cell beyond middle, an additional vein (9) rising out of 8 before bar.

11. *Or. unicolor*, Butl.

(*Psyche unicolor*, Butl., "Proc. Zool. Soc. Lond.," 1877, 381; *Orophora toumatou*, Fdy., "Trans. N.Z. Inst.," 1877, 262, pl. ix.)

♂. 26mm. Head, antennæ, thorax, and abdomen dark grey, clothed with long ochreous-whitish hairs, appearing light grey. Legs dark grey. Wings semi-transparent, strewn with short dark-grey hair-scales, cilia dark grey, tips whitish; forewings very elongate-triangular, costa slightly arched, apex rounded, hindmargin rounded, rather oblique; hindwings broad-ovate.

Rakaia (coll. Fereday). The larva constructs a case covered with pieces of stick, and feeds on low shrubs.

SPHINGINA.

SPHINGIDÆ.

Ocelli absent. Antennæ short, swollen towards middle or posteriorly, apex more or less bent into a slender hook. No maxillary palpi. Abdomen large, conical. Forewings with vein 1 furcate towards base, 2 from near middle of cell, 5 from near middle of transverse vein, parallel to 4, 6 from point with or out of 8, 7 out of 8, 9 out of 10 or absent (coincident with 10). Hindwings with frenulum developed, in ♂ simple, in ♀ sextuple; 1c absent, 5 from near middle of transverse vein, 6 and 7 from a point or stalked, 8 connected with cell by a transverse oblique bar towards base.

The only New Zealand representative of this family is a nearly cosmopolitan insect, possessing great powers of flight, which enable it to cross wide seas.

5. SPHINX, L.

Tongue well developed. Eyes sometimes with marginal cilia. Antennæ $\frac{1}{3}$, swollen towards apex, in ♂ ciliated. Labial palpi moderate, ascending, very densely scaled, terminal joint concealed. Thorax with small tufts on each side of posterior margin. Abdomen without anal tuft. Anterior and middle tibiæ sometimes spinose, posterior tibiæ with all spurs present.

12. *Sph. convolvuli*, L.

(*Protoparce distans*, Butl.)

♂ ♀. 88–96mm. Head and thorax grey; metathoracic tufts black, edged in front with bluish and behind with ochreous-whitish. Abdomen above rosy, posterior margin of segments, except apical, broadly blackish, base of second segment whitish, an uninterrupted dorsal stripe and two apical segments grey. Forewings very elongate-triangular, costa posteriorly moderately arched, apex rectangular, hindmargin very obliquely rounded, waved; rather light brownish-grey; nine more or less well-indicated strongly and irregularly dentate darker grey or dark fuscous transverse lines, somewhat parallel to hindmargin but angulated above middle—viz., two before $\frac{1}{4}$, very indistinct, two before middle, little marked, three about $\frac{3}{5}$, of which two are well marked, and two subterminal, more or less obsolete and broken up to form irregular rings; two long black longitudinal lines beneath middle of disc; an irregular oblique somewhat interrupted black line from apex towards disc: cilia grey, barred with dark fuscous and white. Hindwings grey-whitish, more or less suffused with grey posteriorly; three blackish fasciæ, first at $\frac{1}{4}$, angu-

lated below middle, suffused beneath, second and third roughly parallel to hindmargin, second beyond middle, rather broader; cilia as in forewings.

Taranaki and Napier; sometimes common. I have found the larva at Taranaki feeding on a species of *Convolvulus* growing on the coast sandhills; but it will feed on almost any species of *Convolvulaceæ*. The insect occurs throughout Europe, Asia, Africa, Australia, and the islands of the South Pacific, wherever a suitable situation is found, and has been met with far out at sea. In America it is represented by a form which seems to be regarded as specifically distinct, but I think this is very doubtful.

HYPSINA.

SESIADÆ.

Ocelli present, large. Antennæ about $\frac{3}{4}$, thickened towards apex. No maxillary palpi. Posterior tibiæ with all spurs present. Forewings with vein 1 shortly furcate or simple, 2 from near angle of cell, 7 and 8 stalked, 11 from $\frac{4}{5}$ of cell. Hindwings with frenulum developed, 1c present, 8 free.

This family is a development of the *Zygænidæ*, and has no relationship whatever to the *Sphingidæ*, with which it has been often classed. It is represented in New Zealand only by one artificially-introduced but well-established species.

6. SESIA, F.

Tongue well developed. Antennæ thickened on terminal half, apex sometimes more swollen in ♂, more or less strongly ciliated in ♂, terminating in a small apical fascicle. Labial palpi moderately long, arched, ascending; second joint shortly rough-scaled beneath; terminal joint moderate, cylindrical, tolerably pointed. Abdomen with large expansible anal tuft. Posterior tibiæ rough-haired above. Forewings with vein 7 running to apex. Hindwings with veins 3 and 4 approximated at base or short-stalked, 5 from about middle of transverse vein, 6 absent, 7 from angle of cell.

The neuration of the forewings, as given by me in the "Proceedings of the Linnean Society of New South Wales for 1886," is wrong, and founded on a mistaken comprehension. I now correct it.

13. *Ses. tipuliformis*, Cl.

♂. 18–19mm. Head and thorax black, collar slenderly orange. Palpi black, longitudinally ochreous-yellow beneath. Antennæ black. Abdomen black, with slender ochreous-yellow subbasal, median, and subapical rings. Forewings very narrow, elongate, gradually somewhat dilated, apex obtuse, hindmargin oblique, hardly rounded; colourless,

transparent; a moderate black margin all round; a narrow black fascia on transverse vein; apical half of posterior clear space very dull orange, anteriorly black-margined; veins black, posteriorly broad: cilia black. Hindwings elongate-ovate; colourless, transparent, with a narrow black margin; veins black; a small black triangular spot on upper half of transverse vein: cilia black.

Christchurch to Dunedin; common. Introduced from Europe with the garden currant (*Ribes*), in the shoots of which the larva feeds.

ARCTIADÆ.

Antennæ not thickened. No maxillary palpi. Posterior tibiæ with all spurs present. Forewings with vein 1 simple, 7 and 8 stalked. Hindwings with frenulum developed, 1c absent, 6 and 7 stalked or approximated at base, 8 rising out of upper margin of cell from beyond ⅓, completely coincident with it towards base.

Represented by one cosmopolitan species, and one small endemic genus of Australian affinity. The family is numerous in Australia, and many of the species are lichen-feeders and would find abundant food in New Zealand, but these are principally weak fliers and have perhaps been unable to reach our shores.

Antennæ in ♂ bipectinated; ♀ apterous.. ..	*Metacrias.*
" " filiform; ♀ winged	*Deiopeia.*

7. METACRIAS, Meyr.

Tongue obsolete. Antennæ in ♂ moderately bipectinated throughout. Palpi rather short, hairy, concealed in rough hairs of head. Thorax and femora densely hairy beneath. Anterior tibiæ with developed spine beneath, and apical hook. Forewings with vein 2 from ⅘, 6 from point with or out of 9, 7 and 8 out of 9, 10 sometimes connected with 9 at a point above 7. Hindwings with veins 3 and 4 almost from point, 6 and 7 from point or short-stalked, 8 from about ⅓. Wings in ♀ rudimentary.

An interesting and peculiar genus, apparently most allied to some Australian forms of *Spilosoma*, but quite distinct. Three species have been discovered, two of them quite recently, and it is not unreasonable to hope that additional forms may hereafter be found amongst the mountains, to which they seem especially attached.

1. Hindmargin of hindwings crimson	14. *strategica.*
" " not crimson ..	2.
2. Forewings with a red subcostal streak from base	16. *huttonii.*
Forewings without a red subcostal streak from base	15. *erichrysa.*

14. *Met. strategica*, Hudson.

(*Arctia strategica*, Hudson, "Entom.," 1889, 53.)

♂. 35mm. Head black, forehead ochreous. Thorax black, collar and inner margin of patagia yellow. Forewings black; costa and inner margin narrowly ochreous-yellow; a longitudinal ochreous-yellow streak above middle from base to hindmargin, and another above inner margin; a short yellowish interrupted line before hindmargin beneath apex, and three similar lines, lengthening downwards, between the two longitudinal streaks. Hindwings ochreous-yellow; a broad submarginal black band, interrupted above anal angle; hindmargin crimson-red: cilia ochreous-yellow.

Richardson Ranges (3,000ft.), near Albury; one specimen. I have not seen this species, but Mr. Hudson kindly sent me a coloured figure, from which and his published description I made the above diagnosis. It is evidently very distinct.

15. *Met. erichrysa*, Meyr.

(*Metacrias erichrysa*, Meyr., "Proc. Linn. Soc. N.S.W.," 1886, 749.)

♂. 31–33mm. Head and thorax black. Forewings black; markings orange-yellow; a slender costal streak, much dilated on basal fourth; a slender dorsal streak; a wedge-shaped discal spot before middle; a streak along submedian fold from near base to $\frac{3}{4}$; a curved discal series of five elongate spots about $\frac{2}{3}$; a subterminal series of eight dots or small spots, more or less connected by fine longitudinal lines with hindmargin. Hindwings orange-yellow; a curved black transverse discal spot; a black hindmarginal band, on upper half containing three or four yellow dots, on lower half with an elongate yellow marginal spot sending an acute projection to inner edge of band near anal angle.

♀. Wholly whitish-ochreous; wings minute, aborted; legs short, stout, well developed.

Mount Arthur (4,000ft.); five specimens. Larva wholly black, clothed with long black hairs, those covering segmental incisions brownish-ochreous; feeds on *Senecio bellidioides*; pupa in a slight cocoon.

16. *Met. huttonii*, Butl.

(*Phaos huttonii*, Butl., "Cist. Ent.," ii., 487; *Metacrias huttonii*, Meyr., "Proc. Linn. Soc. N.S.W.," 1886, 750.)

♂. 29mm. Differs from *M. erichrysa* as follows: Head and thorax with some yellow-whitish hairs. Forewings with markings whitish-ochreous; no costal streak; a bright crimson subcostal streak from base to $\frac{1}{4}$. Hindwings yellow, towards base mixed with blackish; spots in hindmarginal band reduced, supra-anal spot moderate, triangular, not reaching edge of band.

Lake Wakatipu; discovered by Professor Hutton, who also observed the apterous ♀.

8. DEIOPEIA, Stph.

Tongue well developed. Antennæ in ♂ filiform, shortly ciliated, with scattered longer cilia. Palpi moderate, arched, ascending; second joint thickened with dense loosely-appressed scales; terminal joint moderate, cylindrical, obtuse. Spurs extremely short. Forewings with vein 2 from $\frac{3}{5}$, 7 and 8 out of 9. Hindwings with veins 6 and 7 approximated at base, 8 from middle.

17. *Deio. pulchella*, L.

♂ ♀. 33–36mm. Head and thorax ochreous-whitish, spotted with black and orange. Forewings ochreous-whitish; six angulated transverse series of black dots between veins, alternating with five series of two or three small subquadrate red spots; four additional black dots transversely placed in disc between fourth and fifth series. Hindwings white; two almost connected small blackish discal spots on transverse vein; a narrow irregular blackish-grey hindmarginal band, dilated into a triangular blotch at apex, and a quadrate smaller blotch below middle.

Wainuiomata; recently observed by Mr. Hudson; probably only an occasional immigrant. Although a feeble-looking insect, it possesses extraordinary capabilities of flight, and is sometimes met with far out at sea. It occurs throughout Europe, Asia, Africa, Australia, and the Pacific Islands.

HYPSIDÆ.

Ocelli present. Antennæ not thickened. No maxillary palpi. Posterior tibiæ with all spurs present. Forewings with vein 1 simple, 7, 8, and 9 stalked. Hindwings with frenulum developed, 1c absent, 6 and 7 stalked or approximated at base, 8 anastomosing with upper margin of cell, separating towards base, or connected by a median bar only.

9. NYCTEMERA, Hb.

Tongue well developed. Antennæ in ♂ bipectinated throughout. Palpi moderately long, porrected or rather ascending, with appressed scales; terminal joint moderate, cylindrical. Forewings with vein 6 out of 9 or separate, 7 and 8 out of 9, 10 connected with 9 by a bar. Hindwings with veins 6 and 7 stalked or separate, 8 anastomosing shortly with margin of cell near base.

The New Zealand species is endemic, but nearly allied to an Australian form.

18. *Nyct. annulata*, Boisd.

(*Leptosoma annulatum*, Boisd., "Voy. Astr.," v., 197, pl. v., 9; Dbld., "Dieff. N. Zeal.," ii., 284: *Nyctemera doubledayi*, Walk., "Bomb.," 392: *Nyctemera annulata*, Meyr., "Proc. Linn. Soc. N.S.W.," 1886, 760.)

♂ ♀. 38–42mm. Head black. Thorax black; margin of collar and a stripe on each side of back, meeting behind, orange. Abdomen orange, base of segments broadly black. Forewings blackish; an orange basal dot beneath costa; an irregular ochreous-white fascia from costa beyond middle towards anal angle, but not nearly reaching it, more or less widely interrupted in middle, and cut by two or three black veins, sometimes reduced to two small spots, or wholly obsolete: cilia black. Hindwings blackish; a roundish ochreous-white spot towards costa beyond middle, sometimes obsolete: cilia black.

Common throughout North and South Islands. Larva black; hairs black; spots large, indigo-blue; dorsal and lateral lines narrow, irregular, reddish-orange; head black; feeds on various species of *Senecio*, sometimes entirely stripping the plants. The imago has the curious habit of soaring in the early morning sunshine, soon after sunrise, in calm fine weather. I have seen them in numbers flying round the tops of trees at a height of over 100ft.

This concludes the above-mentioned groups. I add now descriptions of three species recently received from Mr. G. V. Hudson, of Wellington.

BOARMIADÆ.

Boarmia astrapia, n. sp.

♂ ♀. 33–35mm. Head and thorax pale ochreous, with a slender dark fuscous central longitudinal streak. Palpi pale ochreous, suffusedly mixed with dark fuscous. Antennæ pale greyish-ochreous spotted with dark fuscous. Abdomen pale ochreous. Legs pale ochreous, anterior and middle pair banded with dark fuscous. Forewings with costa moderately arched, hindmargin crenulate; pale ochreous, sometimes brownish-tinged, thinly sprinkled with dark fuscous and black; a short irregular black longitudinal streak from middle of base; lines double, dark fuscous, strongly and acutely dentate; first from $\frac{1}{4}$ of costa to $\frac{1}{3}$ of inner margin, angulated outwards above middle; second from $\frac{3}{4}$ of costa to $\frac{2}{3}$ of inner margin, sinuate inwards on lower half; subterminal parallel to hindmargin, interrupted in middle; traces of a dark fuscous transverse discal mark in middle, connected with costa by an indistinct dentate line; a hindmarginal row of black dots: cilia pale ochreous, base mixed with dark fuscous.

Hindwings with hindmargin rounded, crenate; pale yellowish-ochreous; a fuscous discal dot; a fuscous subterminal line, parallel to hindmargin; hindmargin suffusedly irrorated with fuscous; cilia whitish-ochreous, with a fuscous line.

Wellington; three specimens. It was a ♀ of this species which I formerly described as the ♀ of *B. fenerata*, the two insects being very similar in marking, but differing widely in the shape of the hindwings, which I supposed to be sexual; but I have since received both sexes of *B. astrapia* from Mr. Hudson, who also informs me that the ♀ of *B. fenerata* resembles the ♂ in the peculiar form of hindwings, as well as in colour and markings; thus there can be no doubt of their distinctness.

ŒCOPHORIDÆ.

Œcophora nycteris, n. sp.

♂ ♀. 14mm. Head, palpi, antennæ, thorax, abdomen, and legs dark fuscous; face pale greyish-ochreous; palpi with second joint rough-scaled beneath; posterior tarsi ringed with pale-ochreous. Forewings elongate, costa moderately arched, apex pointed, hindmargin very obliquely rounded; rather dark bronzy-fuscous; a cloudy darker transverse mark at anal angle, reaching half across wing: cilia dark bronzy-fuscous. Hindwings dark fuscous, somewhat lighter towards base; cilia dark fuscous.

Wellington, in November; two specimens received from Mr. Hudson. Although belonging to the ordinary New Zealand type, it is not very near any other species, and is easily distinguished by its general dark colouring.

ELACHISTIDÆ.

Stathmopoda caminora, n. sp.

♀. 12mm. Head whitish-yellowish, slightly ferruginous-tinged on crown, face more whitish. Palpi and antennæ yellow-whitish. Thorax ferruginous, posteriorly pale yellowish. Abdomen and legs whitish, anterior legs infuscated. Forewings elongate, very narrow, slightly broadest near base, long-pointed; pale yellowish; a thick cloudy ferruginous-reddish longitudinal median streak from base to apex, posteriorly dilated so as to extend along hindmargin to anal angle, and abruptly dilated towards base so as to extend to inner margin; a large ferruginous-reddish spot about middle of inner margin, confluent with central streak; a dark-grey longitudinal streak from base of costa to anal angle, traversing central ferruginous streak and lying wholly in it: cilia ochreous-grey-whitish. Hindwings and cilia ochreous-whitish.

Wellington; one specimen received from Mr. Hudson. Apparently very distinct.

Descriptions of Larvæ.

I am also indebted to the zeal and kindness of Mr. Hudson for the following descriptions of larvæ, which are drawn up by myself from notes furnished by him:—

Cidaria deltoidata, Walk. Larva cylindrical, wrinkled, with a few short black hairs; unicolorous dark-brown. Feeds on *Plantago* and probably also other low plants; eggs hatched in March, larvæ full grown in September. Pupa in an earthen cocoon.

Lyrcea alectoraria, Walk. Larva stout, head relatively small, anal segment with fleshy projection; bright green, with numerous fine wavy yellow lines and dots; a series of transverse yellow lines across each segment; an interrupted reddish dorsal line; spiracles, prolegs, and apex of anal projection reddish. Feeds on *Pittosporum eugenioides* in September and October; sluggish in habit. Pupa in a slight cocoon, formed with three or four leaves of the shrub on which it feeds.

Lyrcea hemipteraria, Gn. Larva green, with two yellow lateral lines, lower broader; rarely brown, with a single line. Feeds on various species of *Veronica*, from October to December; in repose it closely resembles a leaf of its food-plant. Pupa amongst refuse on the ground.

Isonomeutis amauropa, Meyr. Lava light yellowish-pink; head brown. Feeds beneath the bark of *Podocarpus spicata*. Pupa in a tough cocoon.

Semiocosma platyptera, Meyr. Larva whitish; dorsal brown; spots brown; head, second segment, and a bisected patch on third light brown. Feeds beneath the bark of dead trees of *Elæocarpus dentatus*, burrowing both in wood and bark, generally appearing to feed near the surface, but having a deeper tunnel into which it retreats when disturbed; full-grown in July. Pupa in a loose cocoon beneath the bark. Imago in September and October.

Œcophora scholæa, Meyr. Larva dark brown, with a whitish lateral line; head pale brown; segments 2–4 whitish, each with a horny plate; prolegs little developed. Feeds in subterranean silken galleries, probably on dead tree-roots; found beneath an old stump.

ART. XXIV.—*Descriptions of New Species of New Zealand Land and Fresh-water Shells.*

By H. SUTER.

[*Read before the Philosophical Institute of Canterbury, 7th November, 1889.*]

Plates XIV. and XV.

SHORTLY after arrival in this beautiful colony, in January, 1887, I began to collect land and fresh-water shells, for a few weeks near Wellington, and afterwards, up to October of last year, in the southern part of the Forty-mile Bush. Since November, 1888, I have collected in the neighbourhood of the Mount Cook Hermitage. I have succeeded in finding a considerable number of new species, all, with a few exceptions, very small and scarce. This circumstance explains fully why they hitherto have been overlooked. In the following pages I wish to give the descriptions of all the new shells I found in the Forty-mile Bush, and of two from the Hermitage. Next winter I hope to be able to complete this paper by giving the descriptions of the animals, as far as they are known to me, their position in the system, and descriptions of some more new species found near the Hermitage.

It is an agreeable duty for me to tender my best thanks to Professor F. W. Hutton, who from the very first assisted me so kindly, up to the present day, with his great knowledge in conchology. I have also to thank Professor A. Mousson, of Zürich, for his valuable communications on New Zealand Mollusca.

Helix pseudoleioda, n. sp. Plate XIV., fig. 1, *a–c*.

Shell small, globose, yellowish-white, banded with somewhat backwards-directed brown streaks, faintly shining, closely ribbed, ribs on upper surface straight, a little undulating outside; ribs about 38 in the tenth of an inch (15 per mm.). Spire globosely elevated, less rounded at the base. Whorls 6, round, very slowly increasing, the last not descending. Suture pretty deep. Aperture lunately rounded, slightly oblique, excavated by the penultimate whorl. Peristome straight, not dilated, acute, margins distant, columellar margin slightly descending. Aperture with 12 laminæ—3 on the penultimate whorl, 1 on the columella, and 8 on the parietal wall. The lowest plait on the penultimate whorl is strongly developed; the plait on the columella also is relatively large, tongue-shaped; the laminæ on the parietal wall are fine, long, the four lower ones are more approached than the others. Umbilicus very narrow, deep, open.

Diameter, 0·09in. (2·25mm.); height, 0·06in. (1·5mm.).

Hab. Under rotten wood and bark in the bush. Not common. North Island: Forty-mile Bush; Hastwell, Mauriceville. (H. S.)

The external appearance is nearly the same as in *Helix leioda*, Hutton: that is why I gave it the name of *pseudoleioda*. It is easily distinguished from *H. leioda*, Hutt., having only 12 laminæ in the aperture, whilst the other has 18.

Helix wairarapa, n. sp. Plate XIV., fig. 2, *a–c*.

Shell depressed, small, light horny brown with brown streaks, which are irregular in breadth, faintly shining, fragile, with close and fine ribs, which are somewhat undulating. Ribs about 38 in the tenth of an inch (15 per mm.). Spire little elevated, nearly flat. Whorls 6, slowly increasing, narrow, the last not descending, rounded. Suture deeply impressed. Aperture slightly oblique, lunately rounded, considerably excavated by the penultimate whorl. Peristome straight, not dilated, acute, margins slightly convergent. Columellar margin not reflected, descending. Aperture with 16 laminæ—5 on the penultimate whorl, 1 on the columella, and 10 on the parietal wall. Of the laminæ on the penultimate whorl the four inferiors are close together, the superior at some distance, all showing the same development. The lamina on the columella is more developed, conical. The laminæ on the parietal wall are fine, long, and nearly regularly distributed over the whole surface. Umbilicus wide, perspective, deep, one-third of the diameter.

Diameter, 0·07in. (1·75mm.); height, 0·04in. (1mm.).

Hab. Under rotten bark in the bush. Not common. North Island: Forty-mile Bush; Hastwell. (H. S.)

Helix hectori, n. sp. Plate XIV., fig. 3, *a–c*.

Shell small, depressed, discoidal, light horny brown with large close brown streaks, not shining, fragile, transparent closely ribbed, ribs nearly straight, about 38 in the tenth of an inch (15 per mm.). Spire nearly flat. Apex bare of epidermis, light-grey. Whorls 5, very slowly but regularly increasing, rounded, the last not descending. Suture impressed. Aperture slightly oblique, rotundly lunar, excavated by the penultimate whorl. Peristome acute, straight, margins convergent. Columellar margin not reflected, descending. Aperture with 14 laminæ—5 on the penultimate whorl, 2 on the columella, and 7 on the parietal wall. On the middle of the penultimate whorl is a stout lamina, which is divided in two by a deep groove, thus getting forked; the other four smaller laminæ are below this one. The laminæ on the columella are

well developed, the inner one with two or three sharp points, the second high, in the shape of a sharp tooth. The plaits on the parietal wall are rather stout, elevated, not very long, and regularly distributed. Umbilicus broad, deep, perspective, nearly one-third of the diameter.

Diameter, 0·09in. (2·25mm.); height, 0·04in. to 0·05in. (1mm. to 1·25mm.).

Hab. Under rotten bark. The most common of the group. North Island: Forty-mile Bush; Hastwell. (H. S.)

Named in honour of Sir James Hector, to whom I am greatly indebted for assistance in my studies of natural history.

Helix microundulata, n. sp. Plate XIV., fig. 4, *a–d.*

Shell depressed, very small, pale horny, with neat brown streaks which are sometimes sharply undulating, otherwhiles forming zigzag lines, but varying in breadth; faintly shining, fragile, with very close ribs. Ribs bent a little forwards on the surface, then going straight downward—60 in the tenth of an inch (25 per mm.). Spire very little elevated, nearly flat; apex bare. Whorls 5, slowly increasing, rounded, the last not descending. Suture impressed. Aperture slightly oblique, rotundly lunar, more excavated in the upper part by the penultimate whorl. Peristome straight, acute, margins not convergent, regularly arched, columellar margin descending. Aperture with 13 laminæ—1 on the penultimate whorl, 2 on the columella, and 10 on the parietal wall. The plait on the penultimate whorl is central, high, but rather thin, forked at the top by a deep and large groove. The two laminæ on the columella are stout, with large base, and both tongue-shaped. The plaits on the parietal wall are fine, long, regularly distributed. Umbilicus deep, broad, nearly one-third of the diameter.

Diameter, 0·07in. (1·75mm.); height, 0·04in. (1mm.).

Hab. Under rotten wood and bark in the bush. Very rare. North Island: Forty-mile Bush; Hastwell. (H. S.) Middle Island: Greymouth. Found one specimen amongst *Helix leioda*, Hutt., sent to me by Mr. R. Helms.

Helix aorangi, n. sp. Plate XIV., fig. 5, *a–c.*

Shell small, depressed, globular, yellowish-white, with somewhat irregular chestnut zigzag or sinuated streaks, faintly shining, thin, transparent. With well-developed ribs, nearly straight, about 38 in the tenth of an inch (15 per mm.). Whorls 5½ to 5, slowly increasing, rounded. Suture impressed. Aperture slightly oblique, rotundly lunar, regularly excavated by the penultimate whorl. The last whorl not descending. Aperture straight, acute, margins slightly

convergent; columellar margin descending, not reflected. Aperture with 12 laminæ—1 on the penultimate whorl, 2 on the columella, and 9 on the parietal wall. The lamina on the penultimate whorl is a little above the centre, high, rather thin, and forked by a deep and broad groove. The two laminæ on the columella are stout, with large base, and tongue-shaped, the first rather sharp. The nine lamellæ on the parietal wall are fine and long—the five lower ones a little stouter, and separated from the other four by a somewhat larger interval. Umbilicus deep, perspective, not very broad, about one-quarter of the diameter.

Diameter, 0·08in. (2mm.); height, 0·05in. (1·25mm.).

Hab. Under dead leaves and rotten wood in the subalpine bush. Rather scarce. Middle Island: Environs of the Mount Cook Hermitage. (H. S.)

This species is closely allied to *H. microundulata*, but it is somewhat larger, more globose, with stronger and more distant ribs. The laminæ of the aperture are nearly equal in both species, but *H. aorangi* has only nine laminæ on the parietal wall.

Helix pseudoleioda, wairarapa, hectori, microundulata, aorangi, and *H. leioda*, Hutton, form together a peculiar and, I think, quite new group, to which I propose to give the name of *Huttonella*, in honour of Prof. F. W. Hutton, who first described a species of this group.

Patula infecta, Reeve, var. *irregularis*, n. var. Plate XIV., fig. 6, *a, b*.

Shell depressed, subdiscoidal, yellowish-white with distant light-brown streaks vanishing on the base, slightly shining, rather thin, transparent; strongly plaited, plaits directed forwards on the surface, and a little undulated descending; about 30 in the tenth of an inch (12 per mm.). The ribs are irregularly developed and distant. Spire slightly elevated. Whorls 5½ to 5, narrowly rolled up, very slowly increasing, rounded, the last very slightly descending. Suture not deep. Aperture rotundly lunar, but little excavated by the penultimate whorl, slightly oblique. Upper margin advancing. Margins straight, convergent, acute; columellar margin nearly vertically descending. The parietal wall inside a little callous, white. Umbilicus broad, perspective, showing all the whorls, about one-third of the diameter.

Diameter, 0·12in. (3mm.); height, 0·06in. (1·5mm.).

Hab. Under rotten logs and dead leaves. Very scarce. North Island: Forty-mile Bush; Hastwell.

This variety is distinguished from *P. infecta* by the slightly-elevated spire, the faint indistinct markings; it is narrower-ribbed, the ribs being irregular in distance and development;

there is one-half to one whorl less, and the diameter of the shell is smaller.

Patula colensoi, n. sp. Plate XIV., fig. 7, *a*, *b*.

Shell discoidal, yellowish-grey, zigzag streaks of dark-brown flowing sometimes together, rather solid, transparent, faintly shining; with strong plaits, directed forwards on the surface, slightly undulating on the side; the interstices striated with growth-lines. Ribs about 20 in the tenth of an inch (8 per mm.). Spire flat. Whorls 5, narrow, slowly increasing, rounded, the last not descending, tapering. Suture deep. Aperture slightly oblique, rotundly lunar, little excavated by the penultimate whorl, margins convergent. Umbilicus broad, perspective, showing all the whorls, about one-third of the diameter.

Diameter, 0·16in. (4·25mm.); height, 0·06in. (2·25mm.).

Hab. Under rotten wood and dead leaves in the bush. Rather scarce. North Island: Forty-mile Bush; Hastwell. (H. S.)

Named in honour of the Rev. William Colenso, F.R.S., the discoverer of the *Unio waikarense*.

This species is near *Pat. infecta*, Reeve, but differs sufficiently from it to justify the creation of a new species: the direction of the ribs on the surface is different; there are only 5 whorls, more rapidly increasing, and the last considerably more developed; the peristome has no callosity; the umbilicus is a little narrower; the diameter is more considerable, the colour darker, the ribs coarser and rather more distant.

Patula variecostata, n. sp. Plate XIV., fig. 8, *a–c*.

Shell discoidal, small, white with large yellow streaks at regular distances, faintly shining, fragile, transparent, with close fine ribs, directed forwards on the surface and going straight down on the side; there is alternately one much higher than the next; interstices striated with growth-lines and reticulated with spirals. Ribs about 38 in the tenth of an inch (15 per mm.). Spire flat, only the first whorls a little elevated. Whorls 5, slowly and regularly increasing, swollen, the last not descending. Suture very deep. Aperture slightly oblique, rotundly lunar, but little excavated by the penultimate whorl. Peristome straight, acute, somewhat tapering, columellar margin nearly vertically descending, upper and lower margin strongly arcuated. Umbilicus broad, perspective, about one-third of the diameter.

Diameter, 0·07in. (1·8mm.), not quite adult; height, 0·04in. (1mm.).

Hab. Under rotten pieces of wood. Very rare. North Island: Mauriceville. (H. S.)

Patula raricostata, n. sp. Plate XIV., fig. 9, *a*, *b*.

Shell small, depressed, subdiscoidal, colour dark olive, not shining, fragile, with distant, stout, dark-brown ribs, bent backwards on the surface and slightly undulating on the side. Ribs about 12 in the tenth of an inch (5 per mm.). Spire slightly elevated. Apex white, bare of epidermis. Whorls 5, slowly increasing, rounded, the last not descending. Suture not deep. Aperture oblique, nearly circular, but very little excavated by the penultimate whorl. Margins convergent. Columellar margin slightly reflected, descending vertically. Lower margin strongly arcuated. Umbilicus broad, deep, showing the last whorls, about one-quarter of the diameter.

Diameter, 0·08in. (2mm.); height, 0·04in. (1mm.).

Hab. In the mould, under dead leaves. Very scarce. The shell is always covered with mud. North Island: Mauriceville. (H. S.)

Diplomphalus subantialba, n. sp. Plate XV., fig. 10, *a*, *b*.

Shell small, discoidal, light-horny to white, somewhat shining, fragile, transparent, very closely and finely ribbed; ribs directed forwards, slightly undulating on the surface, straight on the side, about 90 ribs in the tenth of an inch (35 per mm.). Spire deeply concave, infundibuliform. Whorls 5—the first ones very narrow, the last very large, nearly two-thirds of the diameter; the inner whorls swollen, the last ascending rapidly on the inner side, and falling slowly arcuated to the periphery. Suture very deep. Last whorl not descending. Aperture lunar, small, vertical, strongly excavated by the penultimate whorl. Peristome straight, acute; upper margin narrowly, the lower larger arcuated. Margins convergent. Umbilicus large, deep, perspective, presenting nearly the same aspect as the surface.

Diameter, 0·07in. (1·75mm.); height, 0·03in. (0·8mm.).

Hab. Under rotten wood in the bush, on very damp places. North Island: Forty-mile Bush; Hastwell; Mauriceville. (H. S.)

This shell is a good miniature of *Helix antialba*, Beddone, of Tasmania, but differs from it. I do not think I am wrong in placing our shell in the genus *Diplomphalus*, to which also belongs *Pat. biconcava*, Pf.

Diplomphalus huttoni, n. sp. Plate XV., fig. 11, *a*, *b*.

Shell small, discoidal, light-horny, with fine well-developed ribs, directed forwards and arcuated on the surface, slightly undulated on the periphery; about 40 ribs in the tenth of an inch (16 per mm.). Spire deeply concave, to about one-third of the height. Apex smooth, white, shining. Whorls 4½, the inner ones narrow, the last largely developed, occupying two-

thirds of the diameter, not descending, on the inner side rapidly ascending, regularly arcuated to the periphery. Suture very deep. Aperture lunar, narrow, vertical, much excavated by the penultimate whorl. Peristome straight, acute; upper margin narrowly, lower broader arcuated; columellar margin vertically descending, margins convergent. Penultimate whorl smooth, white, rather callous. Umbilicus broad, deep, perspective, about one-third of the diameter.

Diameter, 0·1in. (2·7mm.); height, 0·04in. (1·5mm.).

Hab. Under rotten logs. Very scarce; only two specimens. North Island: Forty-mile Bush; Hastwell. (H. S.)

Named in honour of Professor F. W. Hutton, F.G.S., to whom I am so greatly indebted for his assistance in conchology.

Diplomphalus moussoni, n. sp. Plate XV., fig. 12, *a*, *b*.

Shell small, discoidal, white banded with brown, the streaks following the direction of the ribs at irregular distances, faintly shining, thin, transparent, strongly ribbed; ribs sharp, directed forwards and arcuated on the surface, slightly undulating on the periphery, straight below, about 18 ribs in the tenth of an inch (7 per mm.). Spire concave to about one-quarter of the height. Apex smooth, shining. Whorls 4, the first 3 very narrow, the last large, two-thirds of the diameter, not descending, on the inner side rapidly ascending, regularly arcuated outside. Suture very deep. Aperture vertical, lunar, excavated by the penultimate whorl. Peristome straight, acute, lower margin regularly arcuated, the upper margin forming a much narrower arch; columellar margin descending nearly vertically, not reflected; margins convergent. Penultimate whorl smooth, white, somewhat callous to a short distance outside the aperture. Umbilicus broad, perspective, about one-quarter of the diameter.

Diameter, 0·15in. (4mm.); height, 0·08in. (2mm.).

Hab. Under rotten logs. Only two specimens. North Island: Forty-mile Bush; Hastwell. (H. S.)

Named in honour of Professor A. Mousson, of Zürich, the distinguished conchologist, who has assisted me in any way he could for the last twenty years.

Hyalina microreticulata, n. sp. Plate XV., fig. 13, *a*, *b*.

Shell very small, globosely elevated, horny-fulvous, shining, very thin, pellucid, finely striated, reticulated between the striæ. Spire conical, elevated. Whorls 5, rounded, regularly increasing. Suture impressed. Aperture oblique, rotundly lunar, but little excavated by the penultimate whorl. Peristome straight, acute, margins faintly convergent; columellar

margin somewhat reflected, descending straight. Umbilicus narrow, deep.

Diameter, 0·07in. (1·7mm.); height, 0·05in. (1·3mm.).

Hab. In mould in the bush. Very scarce; only two specimens. North Island: Forty-mile Bush; Hastwell. (H. S.)

Hyalina allochroida, n. sp. Plate XV., fig. 14, *a–c*.

Shell very small, depressed; the first three whorls colourless, the penultimate yellowish-horny, and the last horny-fulvous; very thin, pellucid, with distant fine ribs, directed backwards on the surface and somewhat arcuated on the side; about 30 ribs in the tenth of an inch (12 per mm.). Distinctly reticulated between the ribs. Spire slightly elevated. Whorls 5, swollen, regularly increasing, the last not descending. Suture deep. Aperture slightly oblique, rotundly lunar, little excavated by the penultimate whorl. Peristome straight, acute, margins convergent, columellar margin slightly reflected, slightly bent downwards. Umbilicus very narrow.

Diameter, 0·06in. (1·5mm.); height, 0·04in. (1mm.).

Hab. Under dead leaves in mould. Scarce. North Island: In the bush, near Mauriceville. (H. S.)

Doubtfully included in *Hyalina*. A variety occurs near the Mount Cook Hermitage.

Hyalina allochroida, n. sp., var. *sericata*, n. var. Plate XV., fig. 15, *a*, *b*.

Shell very small, depressed, yellowish-horny, thin, pellucid, closely and finely ribbed, ribs bent backwards on the surface, slightly undulating on the periphery; about 60 ribs in the tenth of an inch (25 per mm.). Spire slightly elevated. Whorls 5, slowly and regularly increasing, narrow, rounded, the last not descending. Suture deep. Aperture oblique, lunar, higher than broad, little excavated by the penultimate whorl. Peristome straight, acute, upper margin somewhat advancing, columellar margin not reflected, obliquely bent downwards. Umbilicus very narrow.

Diameter, 0·05in. (1·2mm.); height, 0·03in. (0·7mm.).

Hab. Under dead leaves and rotten wood in the bush. Found only one specimen. North Island: Forty-mile Bush; Hastwell. (H. S.)

Hyalina allochroida, n. sp., var. *lateumbilicata*, n. var. Plate XV., fig. 16, *a*, *b*.

Shell very small, depressed, yellowish-horny, shining, pellucid, thin, with rather distant ribs, bent backwards on the surface, oblique and undulated on the periphery. Interstices reticulated. Spire slightly elevated, apex smooth, colourless. Whorls 5, regularly and slowly increasing, narrow, rounded,

the last rather descending. Aperture very oblique, rotundly lunar, little excavated by the penultimate whorl. Peristome straight, acute, margins convergent; columellar margin slightly reflected, accurately bent downwards. Umbilicus open, deep, about one-fifth of the diameter.

Diameter, 0·06in. (1·5mm.); height, 0·04in. (1mm.).

Hab. Amongst dead leaves and mould in the bush. North Island: Forty-mile Bush; Hastwell. (H. S.)

Limnæa alfredi, n. sp. Plate XV., fig. 17, *a*.

Shell oblong, glossy, extremely thin and fragile, horn-coloured, semi-transparent, longitudinally plaited. Apex blunt, very often eroded. Whorls 4, rather flattened. Suture deep. Aperture ovate, more than half the length of the shell. Peristome simple; the outer lip thin, not reflected; the inner lip slightly callously reflexed, covering the umbilicus. Columellar plait very small.

Specimens from Governor's Bush Creek: Length, 0·3in. (7·5mm.); diameter, 0·16in. (4mm.); aperture—long 0·18in. (4·5mm.), broad 0·12in. (3mm.).

Specimens from Birch Hill Lagoon: Length, 0·37in. (9·5mm.); diameter, 0·2in. (5mm.).

Hab. On stones and sand, covered with *Algæ*. South Island: Small creek from Governor's Bush (near Mount Cook Hermitage); Birch Hill Lagoon (seven miles from Hermitage).

Under the influence of the atmosphere the organic part of the shell gets easily decomposed, and the shell becomes so fragile that it hardly can be touched without breaking. I think the water contains very little carbonate of lime. I give it the name of my son Alfred, who discovered this shell near Governor's Bush.

EXPLANATION OF PLATES XIV. AND XV.

PLATE XIV.

Fig. 1. *a*, *b*. *Helix pseudoleioda*.
  " *c*. Its aperture, showing disposition of lamellæ.
Fig. 2. *a*, *b*. *Helix wairarapa*.
  " *c*. Its aperture, with lamellæ.
Fig. 3. *a*, *b*. *Helix hectori*.
  " *c*. Its aperture, with lamellæ.
Fig. 4. *a*, *b*. *Helix microundulata*.
  " *c*. Its aperture, and lamellæ.
  " *d*. Part of the shell, showing the ribs and brown streaks.
Fig. 5. *a*, *b*. *Helix aorangi*.
  " *c*. Its aperture, and lamellæ.
Fig. 6. *a*, *b*. *Patula infecta*, var. *irregularis*.
Fig. 7. *a*, *b*. *P. colensoi*.
Fig. 8. *a*, *b*. *P. variecostata*.
  " *c*. Showing the arrangement of the ribs.
Fig. 9. *a*, *b*. *Patula raricostata*.

PLATE XV.

Fig. 10. *a, b. Diplomphalus subantialba.*
Fig. 11. *a, b. D. huttoni.*
Fig. 12. *a, b. D. moussoni.*
Fig. 13. *a, b. Hyalina microreticulata.*
Fig. 14. *a, b. H. allochroida.*
" *c.* Part of the shell, showing the ribs and reticulated interstices.
Fig. 15. *a, b. Hyalina allochroida,* var. *sericata.*
Fig. 16. *a, b. H. allochroida,* var. *lateumbilicata.*
Fig. 17. *a. Limnæa alfredi.*

ART. XXV.—*Notes on a Collection of* Pselaphidæ *from the Neighbourhood of Clevedon, Southern Wairoa.*

By Captain T. BROUN.

[*Read before the Auckland Institute, 19th August, 1889.*]

MR. GEORGE MUNRO, of Clevedon, having been kind enough to carry out my wishes regarding the collection of *Pselaphidæ*, I am thus in a position to add three new species to our already tolerably large list. These species, whose descriptions are attached, have been named as follow: *Bryaxis munroi*, *B. forficulida*, and *B. foveatissima*. The first-named species is dedicated to the discoverer. The male is remarkable on account of the armature of the front coxæ, which bear long spine-like processes; by the presence of a pair of acute slender tubercles on the hind part of the basal segment of the abdomen; and, further, by the first joint of the posterior tarsus being furnished with a slender, elongate, spiniform protuberance, several times longer than the joint itself. In other respects the insect, or, more correctly speaking, the body, appears somewhat similar to *Bryaxis dispar*, *B. impressifrons*, and *B. fraudulenta*, but the structure of the antennæ is essentially different. I need not in this place enter into details pertaining to these important and curiously-formed organs, as they are fully described in the annexed papers. The second species, *Bryaxis forficulida*, is another curious well-differentiated form—in fact, it is, I believe, without parallel among the group *Pselaphidæ*—I had almost stated, among the order *Coleoptera*, and might indeed have said so had I not recollected that an Australian genus of the *Rhyncophora*, or weevil tribe, bears nearly similar organs. The hind-body and elytra conjointly form an elongate-oval figure terminating in a pair of appendages, or forceps, not unlike those of an earwig—indeed, so much alike are they that the specific name is intended to indicate the resemblance. I am sorry to say I have seen but one specimen, the only one that has been found

as yet. The third species, *Bryaxis foveatissima*, is primarily distinguished by the presence of four foveæ placed in a transverse row on the front of the head. The genus *Bryaxis* consists of a large number of species from Europe, North America, Japan, and other regions. In these species there are usually two frontal and two interocular foveæ: sometimes the former are obsolete or but little developed, in other cases the two on the vertex are indistinct or wholly absent; it seldom happens that all four foveæ are distinctly impressed. In the present instance the interocular impressions are well marked—quite as distinctly as the frontal ones—so here we have another easily-recognised species. I may here state that considerable value is attached to these foveæ on the head as a means of classification: one European author, Herr Reitter, of Vienna, has even proposed to establish a new genus, to be made up of such species of *Bryaxis* as exhibit well-developed frontal foveæ —at any rate, that is one of the characteristics he relied on.

I feel very much gratified at the result, so far, of Mr. Munro's researches. It is only about a year ago that he began collecting beetles near his residence, and soon after I had explained to him my desire for "minute reddish insects," and the different ways in which they may be captured, he set to work, and found not only the three curious species already referred to, and some smaller *Euplectus* allies not yet determined, but also male examples of species that had been described from specimens of the other sex only. These, I may add, are a great acquisition to a typical collection.

The brief remarks I have offered may serve as an encouragement to others who may feel disposed to devote some of their leisure to the collection of the smaller creatures of New Zealand—creatures which, I fear, are doomed to extinction during the process of "land-improvements," so called: reckless waste or irremediable destruction of splendid forests might, I often think, more aptly express what goes on.

Bryaxis munroi, n. sp.

Impunctate, shining, red, head and thorax darkest, tarsi fulvous; clothed with elongate conspicuous hairs.

Head uneven, the sides broadly raised, the interval depressed owing to the foveæ appearing confluent, the interocular foveæ well marked. *Thorax* widest before the middle, each side with a fossa-like contraction behind. *Elytra* ample, somewhat curved laterally, sutural striæ fine but distinct. *Legs* elongate; posterior *tibiæ* a little bent near the extremity; basal articulation of hind *tarsi* armed with an elongate, spiniform, slender process extending more than half-way along the second joint. Under-side pubescent.

Male.—Antennæ hirsute, 10-articulate: basal joint longest, cylindric; 2nd and 3rd joints longer that broad; 4th rather shorter than these; 5th nearly twice the length of 4th; 6th shorter than the preceding one; 7th almost quadrate; 8th transverse; 9th largest, nearly obconical, not exactly truncate at apex, acuminate towards one side at the extremity; 10th almost rotundate, with a short, broad, terminal protuberance hollowed out underneath; the two apical joints asperate. *Prosternum* somewhat granulated on the middle. Anterior *coxæ* armed with elongate spines. Basal segment of *abdomen* very large, bearing a pair of spiniform tubercles near its extremity; intermediate segments much reduced, almost linear.

Female.—Antennæ similar in structure to those of the other sex, except as follows: 11-jointed; 9th joint considerably larger than 8th, quadrate; 10th nearly twice the breadth of its predecessor; 11th largest, subovate, obtusely prominent at apex.

In facies this species resembles Nos. 234, 235, and 1,699. *B. dispar* is at once differentiated by the form of the terminal joints (9 and 10) of the antennæ. In *B. impressifrons* all but the four basal joints of the antennæ have a roughened aspect; and the protuberance of the penultimate articulation assumes the form of a hook directed backwards; and, moreover, the sculpture of the head and thorax is altogether different. In *B. fraudulenta* the last six antennal joints are rough-looking, and, what is more characteristic, the head is angularly produced between the antennæ, and seems plane above when viewed in certain ways.

Length, $\frac{7}{8}$ line; breadth, $\frac{3}{8}$ line.

The species is dedicated to Mr. George Munro, of Clevedon, to whom I am indebted for seven specimens, as well as numerous examples of other species of this interesting group.

B. forficulida, n. sp.

Elongate, convex, nitid; elytra and legs of a paler red than the other parts of the body.

Antennæ stout, not short, pubescent, 10-articulate: basal joint rather larger than 2nd, and somewhat flattened above; 3rd and 4th nearly equal, and bead-like; 5th not so large as 2nd, yet larger than the preceding one; 6th shorter than 5th; 7th and 8th quite transverse; 9th large, subquadrate, oblique at apex, foveate below; 10th as broad as 9th, at least one-third longer, obtusely pointed; these two terminal joints roughish. *Head* smooth, frontal foveæ obsolete, the vertical small but distinct. *Thorax* unimpressed, widest before the middle. *Elytra* oblong, sutural striæ finely marked; they bear some minute brassy hairs. *Hind-body* much narrowed

posteriorly, as long as elytra, not much deflexed, pubescent, its segments very distinct, the terminal furnished with a pair of yellow forceps. *Legs* elongate, hind tibiæ a little flexuous.

This very curious creature is, I believe, without parallel in the *Pselaphidæ*. The elytra and hind-body conjointly form an elongate-oval figure terminating in a pair of appendages not unlike those of an earwig. The antennæ nearly resemble those of Nos. 236, 239, and other allied forms. Fem. incog.

♂. Length, $\frac{7}{8}$ line; breadth, $\frac{3}{8}$ line.

The only specimen I have seen was picked out from a collection which was sent by Mr. George Munro, of Clevedon.

B. foveatissima, n. sp.

Body infuscate, glabrous, shining, and, owing to the abruptly-deflexed abdomen, appearing somewhat shortened behind, where it is broadest; legs and antennæ yellow.

Head subquadrate; antennal tubercles but little elevated, and seeming to form a continuous smooth linear space between the antennæ, immediately behind this there is a row of four small but distinct foveæ, and on the vertex two other foveæ. *Antennæ* moderately short and stout, pubescent, 2nd articulation nearly as long as the exposed portion of the basal one; 3rd rather longer than 4th, both of which are narrowed towards the base; 5th distinctly broader but not longer than 3rd, not symmetrical, being a little cut away towards one side; joints 6–8 broader than the preceding ones, transverse, united together by narrow central stalks so that evident gaps exist between the wider parts; 9th largest, oblong, with a median cavity near the front; 10th half the bulk of the penultimate, obtusely produced: the two last-mentioned punctate. *Thorax* smooth, widest just before the middle. *Elytra* large, widest behind, sutural grooves not deeply impressed. *Hind-body* smooth, very sparingly and indistinctly clothed, nearly vertical. *Legs* stout; anterior tibiæ medially incrassate; intermediate gradually dilated, but tapered off near the extremity; posterior bicurvate, inwardly near the base and outwardly beyond.

The laxly-articulated 6th, 7th, and 8th antennal joints, and the presence of four frontal foveæ, will lead to the recognition of this species. The former character is not, I find, confined to this species. Its nearest allies are *B. impar* and *B. munda.* The structure of the under-side I have been unable to examine.

♂. Length, $\frac{5}{8}$ line; breadth, quite $\frac{1}{4}$ line.

Discovered near Clevedon by Mr. G. Munro. Only one has been obtained as yet.

Art. XXVI.—*Description of a New Species of* Argiope, *from Fiji.*

By A. T. Urquhart.

[*Read before the Auckland Institute, 14th October, 1889.*]

Fam. EPEIRIDÆ.

Gen. **Argiope**, Sav. et Aud.

Argiope leuco-picta, sp. nov.

Female.—Ceph.-th., long, 8; broad, 7; facial index, 2·5. Abd., long, 14; broad, 9. Legs, 1, 2, 4, 3 = 36, 33, 30, 21 mm.

Cephalothorax olive-brown, tinted with slate-colour, margined by an interrupted yellowish band; ocular area reddish-brown; fairly clothed with silky, white, adpressed hairs; length equals the tibial joint of a leg of 1st pair; pars cephalica somewhat aplanate, sides moderately rounded, lateral index 1·8mm.; eye-eminence projects forwards; pars thoracica depressedly convex, sides well rounded; fovea somewhat circular, large and moderately deep; radial and caput striæ well defined; profile-contour rises rather abruptly from thoracic junction, dips into median fovea, slopes forwards across the cephalic part with a slight curve; depth of *clypeus* equals diameter and a half of a fore-central eye.

Eyes on small black rings; posterior row slightly recurved; median pair separated by an interval exceeding their diameter and one-half, about twice that distance from fore-centrals, perceptibly more than their space from lateral eyes of same row; anterior row strongly recurved, centrals perceptibly larger than hind pair, placed slightly nearer to one another; their space from lateral eyes, which are rather smaller than posterior centrals, posited obliquely on a common tubercle, three-fourths their breadth from one another.

Legs yellowish olive-brown, femora clouded and irregularly annulated with a greenish dark chocolate-brown; patellæ suffused with a dark tinge; tibiæ and metatarsi have three broad, not well-defined, annuli of the normal colour; legs strong, each femur is equal in length to the patella and tibia, and the two latter articles equal the metatarsus and tarsus; superior tarsal claws—1st pair rather coarse, 6 teeth increasing in length and strength, 3 basal close; free end bent, enlarged near base; inferior claw stronger than superior, rather sharply bent, apex curved outwards; first tooth long.

Palpi brownish-yellow, broken brown annuli; length 9·5; humeral joint in length is equal to the cubital and radial

together; two latter articles equal to digital joint; armature sparse fine hairs, numerous bristles, especially on penultimate and terminal joints; palpal claw 8 teeth, 2 basal small, 6 open teeth; free end bent forwards, base enlarged.

Falces brownish-yellow, base suffused with olive-green, apex light-brown; vertical, somewhat conical, project at base in front; length 3mm., breadth exceeds one-half length.

Maxillæ dark chocolate-brown, apices yellowish on inner side; spathulate, rather longer than broad, directed towards each other.

Labium dark chocolate-brown, yellowish apex; rather broader than long, roundly pointed, moderately everted.

Sternum dark chocolate-brown; central mark yellowish, undulating, acuminate; cordate; eminences opposite coxæ well developed.

Abdomen oviform, about as deep as broad, slightly convex above, projects forwards and upwards over base of cephalothorax; displays a tubercular eminence in front; from the somewhat pointed prominence at posterior end the abdomen dips abruptly inwards to spinners; lateral margins corrugated; humeral processes moderately developed, rounded, directed upwards and outwards, placed rather close together and somewhat forward; the integument, with the exception of a large stone-coloured somewhat circular patch on fore-part, extending backwards to base of humeral processes, has a soft velvety appearance, is of a rich-brown colour, clouded with a deeper hue (appears nearly black to the unaided eye); the darker portions sparsely clothed with erect black hairs, and the stone-coloured pattern with silky, white, adpressed hairs; dorsal field elongate-oval, moderately constricted in centre, defined by a series of spots; basal half enclosed by six spots; anterior pair rather large, lunulate, partially encircle humeral processes on outer side; four hind spots much smaller, somewhat similar in form; posterior half bordered by more or less connected dots; on fore-half is a plier-shaped figure, formed by two short parallel lines extending from anterior pair of impressed spots to stone-coloured area, between them is a pale spot; diverging backwards from near the latter are two lines thickening and curving inwardly above the second pair of impressed spots; six dots occur between the latter spot and posterior end of the oval field, four form a quadrilateral figure at the constriction, two midway between them and posterior end of dorsal field; on lateral margins are two interrupted lines, following the contour of the median area—upper defined by a series of somewhat elongated dots, second row chiefly formed by three moderately-curved marks; few interrupted oblique lines converge towards spinners; sides and ventral surface olive-green tinge; shield bordered by a broken, undulating, stone-coloured

line; eight dots form a double row in centre. *Corpus vulvæ* reddish-brown, yellow spot at either end; more than twice as broad as long; centrally prolonged into a short, obtuse projection; lateral margins curve inwardly, terminate in somewhat oval shallow concavities; a moderately broad septum intersects two shallow pyriform foveæ.

This handsome species, which is, as far as I am able to ascertain, new to science, was kindly communicated to me by *P. Goyen, Esq.*, of Dunedin.

Art. XXVII.—*On Two Species of* Aranea *new to Science, from the Jenolan Caves, New South Wales.*

By A. T. Urquhart.

[*Read before the Auckland Institute, 11th November, 1889.*]

Plate XVI.

Fam. THERIDIIDÆ.

Gen. **Linyphia**, Latr.

Linyphia weburdi, sp. nov. Plate XVI., fig. 2.

Female.—Ceph.-th., long, 1. Abd., long, 1·2. Legs, 1, 4–2, 3.

Cephalothorax fulvous, radii faint-black; few black bristle-like hairs; areolate; oval, lateral constriction at caput slight; pars cephalica convex, somewhat squarely truncated; pars thoracica convex, fovea large, oval; striæ faint; profile-contour slopes backwards, with a slight double arch, at a moderate angle, to thoracic junction; *clypeus* convex, directed forwards, depth exceeds one-half facial space.

Eyes pearl-grey, posited on dark rings; of tolerable and nearly equal size, except the fore-centrals, which are much the smallest of the eight; posterior row procurved, median pair perceptibly the largest, separated from each other by an interval visibly exceeding an eye's diameter; more than that space from laterals of same row; anterior row slightly recurved; centrals placed about their diameter apart; separated from side-eyes by an interval scarcely equalling their space; laterals seated obliquely, about their radius from one another, on moderate tubercular eminences.

Legs yellowish-amber colour; long, slender, of nearly equal length; first pair, 5mm.; hairs black, fine; bristles sparse; femoral joints of two first pairs armed with spines; patellæ have one long spine; strongish long spines on tibiæ; single spine on metatarsi.

Palpi colour and armature of legs; no claw.

Falces light burnt-umber colour; length rather exceeds depth of facial space; project perceptibly forwards; second half somewhat attenuated and divergent; four rather close teeth on inner row; three strong teeth on outer.

Maxillæ large, somewhat oval, apex roundly truncated, slightly inclined towards *labium*, which is short, breadth exceeds length, much everted; colour of organs yellow-brown.

Sternum chocolate-brown; broad-cordate, eminences opposite coxæ.

Abdomen oviform; pale-grey, posterior half clouded with slaty-black, patch of a similar colour on base. *Corpus vulvæ* represents a large, brownish, transversely-wrinkled cucullus, nearly as broad as long; sides prolonged into rather wide processes, concave on inner side, apices rounded, beaded; projecting from within, and rather beyond the lateral processes, is a yellowish broad scape, apex rounded, beading reddish.

A single specimen of this small species was contained in a collection kindly sent me by *Mr. Voss Weburd*, who captured it in the Jenolan Caves.

Fam. LYCOSIDÆ.

Gen. **Cycloctenus**, L. Koch.

Cycloctenus abyssinus, sp. nov. Plate XVI., fig. 1.

Female.—Ceph.-th., long, 3·5; broad, 3. Abd., long, 3; broad, 2. Legs, 4, 1–2–3 = 16, 15 mm.

Cephalothorax light raw-sienna; marginal band narrow, brown; middle band sinuate fringe of dark hairs; sparsely furnished with rather coarse orange-red and black hairs; cephalothorax in length equals tibial joint of a leg of third pair; pars cephalica convex, somewhat quadrate, one-half breadth of thorax; pars thoracica circular, convex; border hem rather broad; indentation reddish, long, narrow, longitudinal; striæ shallow; profile-contour represents a double arch; *clypeus* directed moderately forwards, depth about equal to breadth of anterior row of eyes.

Eyes on dark rings; anterior pair sensibly recurved, small, three-fourths their breadth from each other; their diameter and a quarter from median eyes of central row; second row slightly recurved, centrals large, about equal to posterior pair in size, separated by an interval nearly equalling three-fourths of an eye's breadth; scarcely that space from laterals, which are rather the smallest of the eight, have a pearl-grey lustre; eyes of third row posited on low tubercular eminences, divided from median pair of second line by an interval visibly exceeding their own diameter; form with latter pair a strongly recurved line.

Legs and cephalothorax concolorous, faint-blackish annuli; moderately slender, of nearly equal length and strength, furnished with fine yellowish and black hairs; femora armed with 5 or 6 long spines; patellæ 1; tibiæ of first and second pairs have 11 long spines on under-side, 2 strong bristles above; 10 spines on metatarsi; tibial joints of two hind pairs armed with 8 or 9 slighter spines; metatarsi 8; claws long, somewhat slender, moderately and evenly curved, project upwards, free end longest; superior tarsal claws of first pair have 11 comb-teeth increasing in length and strength; inferior claw sharply curved, 2 comb-teeth, basal rather the shortest; superior claws of fourth pair 4 teeth; inferior claw 2, shorter than those of first pair.

Palpi colour and armature of legs; length 5mm.; palpal claw long, slender, slightly curved, 2 teeth at base, outer longest.

Falces light mahogany-brown; armed with hairs and few bristles on basal half; conical, project at base in front, inclined sensibly inwards.

Maxillæ long, spathulate, slightly inclined towards *labium*, which is somewhat quadrate, apex concave; one-third length of maxillæ; organs mahogany-brown.

Sternum and legs concolorous; sparse black hairs; broad-ovate.

Abdomen oviform, posterior end widest, base slightly truncated, moderately convex; rather thickly clothed with coarse yellowish hairs; yellow-brown, two somewhat acute brown marks on base; four spots in centre of back; series of faint blackish flecks on lateral margins; few dark marks about spinners. *Corpus vulvæ* represents a large triangular area, apex directed forwards; centre somewhat depressed, reddish-chocolate colour; the margins—except the base, which displays a large, somewhat reniform, orange-red lobe—are beaded, broad, colour of lobe.

Male.—Two immature males did not differ essentially in form or coloration from the female examples.

Jenolan Caves, *Voss Weburd*, A. T. U.

EXPLANATION OF PLATE XVI.

Fig. 1. *Cycloctenus abyssinus*, sp. nov. Female, three times natural size: *a*, tarsus of fourth leg; *b*, claw of palpus; *c*, vulva; *d*, eyes.

Fig. 2. *Linyphia weburdi*, sp. nov. Female, ten times natural size: *a*, vulva.

The Jenolan Caves form a group of nine caverns in the series of caves that occurs in the coral limestone range that

extends from Mudgee to Goulburn. Seven of them possess galleries and chambers of considerable extent, and are remarkable for the variety of form and beauty of their stalactites and stalagmites. An underground river, of some interest, flows through two of them.

The other two caverns are merely grand arches rising to a height of about 300ft.

These caves were formerly known as the Binda, or Fish River Caves, and were apparently known to Europeans as early as 1831.

They are about 114 miles from Sydney, and of easy access. The Government recently proclaimed the district in which they are situated a public reserve, erected necessary buildings, and appointed a curator.

ART. XXVIII.—*Descriptions of New Species of* Araneidæ.

By A. T. URQUHART.

[*Read before the Auckland Institute, 14th October, 1889.*]

Plate XVII.

Fam. EPEIRIDÆ.

Gen. **Epeira**, Walck.

Epeira flavo-maculata, sp. nov.

Female.—Ceph.-th., long, 3·5; broad, 3; facial index, 1. Abd., long, 7; broad, 5·2. Legs, 1, 2, 4, 3 = 14, 12, 11, 8 mm.

Cephalothorax mottled, dull light-brown; hairs very sparse; oval, moderately compressed forwards; pars cephalica slightly convex, ocular prominence low, lateral index nearly equals space between posterior side-eyes; pars thoracica depressed, fovea deep, circular; caput and radial striæ faint; profile-contour represents a low arch; *clypeus* vertical, height about equal to radius of a fore-central eye.

Eyes, fore and hind rows recurved; posterior centrals separated by rather more than their diameter from one another; their space and a quarter from lateral eyes; anterior centrals perceptibly larger than hind pair; their breadth and a quarter from each other, rather less than that interval from posterior centrals; lateral eyes rather smaller than posterior median pair, posited obliquely, their diameter apart, on low, black, tubercular eminences.

Legs and cephalothorax concolorous; slender; hairs yel-

lowish, sparse; spines yellowish; moderately numerous; tibial spines of 1st pair scarcely equal diameter of article in length.

Palpi yellow-brown, terminal joints tinted with olive-green; rather exceeds tibial joint of 1st pair in length.

Falces colour of cephalothorax; vertical, conical, project at base in front.

Maxillæ yellow-brown; scarcely as long as broad, truncated.

Labium yellow-brown; rather broader than long, somewhat pointed, everted, less than one-half length of maxillæ.

Sternum yellow-brown; cordate, slight eminences opposite coxæ.

Abdomen oviform, somewhat depressed above; integument dull slaty-brown, thickly speckled with light stone-coloured yellow-spotted flecks; three pairs of impressed spots—two oblique, somewhat pyriform, slaty-brown marks enclose the first pair; between the hind pair is a swallow-like figure of similar colour; close to it, on posterior side, is smaller and less defined figure, similar in form; from the latter four parallel yellowish lines extend to spinners; ventral surface less thickly flecked. *Vulva* amber-colour; hood rather broader than long, moderately convex, transversely wrinkled; length of scapus vulvæ exceeds depth of hood by one-third, about two-thirds less than it in breadth; transversely rugose; apex calceolate; attached to the scapus, inferior end, are two dark-tinted, subconical, wing-like projections.

A single example of this species was contained in a collection kindly sent me by *T. Kirk, Esq., F.L.S.*, from Wellington.

Epeira albo-stricta, sp. nov.

Female.—Ceph.-th., long, 3·2; broad, 2·8; facial index, 1. Abd., long, 7; broad, 6·5. Legs, 1, 2, 4, 3=12, 11·5, 11, 7 mm.

Caput sienna-brown clouded with brown, thoracic part light olive-brown, margins suffused with olive-green; almost glabrous; oval, moderately compressed forwards; pars cephalica slightly convex, roundly truncated, ocular eminence moderately developed; lateral index equals facial; pars thoracica moderately convex; fovea not deep; normal grooves slight; profile-contour rises from thoracic junction at an angle of 40°, slopes forwards with an even line, rising slightly at eye-eminence; *clypeus* in depth exceeds diameter of a fore-central eye.

Posterior row of *eyes* perceptibly recurved, median pair on dark spots; separated from each other by an interval visibly exceeding an eye's breadth; nearly their space and a half from

side-eyes of same row; anterior row recurved; centrals, which equal hind pair in size, form with them a trapezoid widest in front; placed rather further from each other than they are from posterior pair; lateral eyes rather smallest of eight, posited obliquely, their radius from each other, on low, separate, tubercular prominences.

Legs, femoral joints of first and second pairs pale yellowish-red, streaked and faintly banded with reddish-purple; other articles straw-colour, apices of metatarsi and tarsi reddish-brown; thighs of third and fourth pairs have a deeper purple tinge; tibiæ and metatarsi rather more pronounced annuli, which are in first pairs scarcely perceptible. Legs rather slight; hairs pale, very sparse; spines straw-colour, base dark, moderately numerous; tibial spines on first pair equal diameter of article in length.

Palpi straw-colour, moderately armed with hairs and slender spines.

Falces glossy, deep straw-colour, faintly suffused with olive-green; conical, vertical, about as long as a femoral joint of second pair.

Maxillæ yellowish, base dark; spathulate, rather longer than broad, inclined towards each other.

Labium dark-brown, apex pale greenish-yellow; about as long as broad, pointed, everted.

Sternum chocolate-brown, yellow mark in centre; cordate, eminences opposite coxæ.

Abdomen, base rounded, projects over cephalothorax; depressed above; rather longer than broad between humeral protuberances, which are only moderately developed; ground-colour creamy-white, suffused with curved, intricate, broken lines, formed by small purple dots; a broad, undulating, creamy-white, purple-margined band connects the humeral prominences; at either extremity of band is a large black patch, chiefly on the fore-side; a looped chain of rather large whitish spots converges forwards from base of tubercles, convexity of loops directed backwards; base of abdomen covered with rather large whitish spots intersected by purple lines, few black stains. Coloration on ventral surface runs into oblique, undulating broken streaks; shield brownish, margins not well defined, two pairs of pale impressed spots. *Corpus vulvæ* yellow amber-colour; represents a rather convex transversely-wrinkled area, about twice as broad as long at curvature; scapus very broad, contracts a little in front; margins display two large, somewhat ear-shaped lobes, intersected by a parallel convexity formed by three well-defined rings, to which the apex of the scapus, a broadly-conical cap, is closely articulated.

Taken on *Leptospermum*, Bluff, Otago, *A. T. U.*

Epeira guttatum, sp. nov. Plate XVII., fig. 4.

Female.—Ceph.-th., long, 3; broad, 3; facial index, 1·2. Abd., long, 8; broad, 8. Legs, 1, 2, 4, 3 = 12, 11, 10·5, 7 mm.

Cephalothorax light brownish-yellow, cephalic part suffused with lake about the eye-area, clouded and streaked with olive-brown; thorax lightly suffused with olive-brown; hairs yellowish, short, sparse; length equals tibia of a leg of 1st pair; sides well rounded, lateral constriction at caput tolerably strong; pars cephalica moderately convex, ocular eminence low, lateral index equals facial; pars thoracica somewhat convex, fovea rather circular, normal grooves moderately defined; profile-line dips from limit of caput to thoracic junction at an angle of 45°, slopes less abruptly forwards; depth of *clypeus* equals breadth of a fore-central eye.

Fore and hind row of *eyes* moderately recurved; curvature of posterior line nearly equals that of the anterior; eyes on dark rings; hind-centrals equal fore-centrals in size, divided by an eye's breadth, rather more than their space from laterals of same row; anterior median pair separated from each other by their diameter and a half, rather less than that interval from posterior centrals; laterals rather smallest of eight, interspace perceptibly less than their radius, posited obliquely on moderately strong tubercles.

Legs brownish-yellow; femora of first and second pairs lightly suffused with lake colour; tinge more pronounced on femoral joints of third and fourth, which have broken chocolate-brown rings on the fore-end; tibiæ, metatarsi, and tarsi have two brown annuli; annulations on front pairs faint; hairs sparse; spines yellowish, dark base, moderately strong, and numerous.

Palpi brownish-yellow; light-coloured hairs and spines; equal in length to metatarsal and tarsal joints of 2nd pair.

Falces yellowish, green tinge, clouded with olive-green; conical, gibbous at base in front, vertical, nearly equal in length to radial and digital joints of palpus.

Maxillæ obtusely pointed, nearly as broad at fore-end as long, inclined towards *labium*, which is oval, nearly as long as broad; organs dark chocolate-brown, greenish-yellow apices.

Sternum dark chocolate-brown, yellow central mark; broad-cordate, eminences opposite coxæ.

Abdomen somewhat oviform, moderately depressed above, projects over base of cephalothorax; humeral tubercles moderately prominent; hairs very sparse; ground-pattern formed by a series of intricate sinuate curved lines, and flecks of a purple-tinted white colour, intersected by purple streaks; base thickly spotted with large creamy-white lobate flecks, which gradually transform into broken oblique streaks on lateral

margins; this group of flecks on the posterior side forms a somewhat even line, converging forwards from base of humeral processes; a series of large disconnected flecks curve round fore-side of tubercles and form two procurved loops, leaving an open space between them and the similarly-curved margin in front; four dark impressed spots form a trapezoid, narrowest in front; shield-like figure on ventral surface somewhat linear-ovate; brown, purple spots; four impressed dots represent a nearly quadrilateral figure. *Vulva* displays a clouded brownish-yellow, transversely rugose corpus, flattened above, widening out at base of the scapus vulvæ, whose curvature is somewhat abrupt; scapus large, contracts a little forwards, margins represent two large ear-like lobes, intersected by a wrinkled, subcylindrical truncated ridge; the broad, conical, cap-shaped apex of the scapus vulvæ is attached to a rather short transversely-wrinkled petiole projecting from within the central ridge.

This specimen was taken on *Leptospermum*, Bluff, Otago, *A. T. U.*

Epeira ostri-brunnea, sp. nov. Plate XVII., fig. 5.

Female.—Ceph.-th., long, 4·5; broad, 4; facial index, 2·4. Abd., long, 9; broad, 8·5. Legs, 1, 2, 4, 3 = 16, 15, 14, 9 mm.

Cephalothorax lake-brown; hairs on thoracic part whitish, rather sparse; length equal to patella and tibia of a leg of 4th pair; sides moderately rounded; lateral constrictions at caput slight; pars cephalica only moderately depressed above, mammiform eminences and eye-prominence somewhat pronounced; lateral index scarcely exceeds one-half facial; pars thoracica convex, indentation transverse; normal grooves slight; profile-line rises from thoracic junction at an angle of 20°, represents a slight curve across caput, rising at ocular prominence; *clypeus* inclined somewhat inwards, depth exceeds diameter of a fore-central eye.

Fore and hind row of *eyes* about equally recurved; centrals form a nearly quadrilateral figure, slightly widest in front; posterior centrals nearly one-third smaller than anterior pair, separated from one another by an interval scarcely exceeding twice their diameter, divided from fore-pair by an eye's breadth and a quarter; twice their space from laterals of same row; interval between anterior centrals perceptibly exceeds their breadth; divided by their space and a half from side-eyes; laterals about one-fourth the size of fore-centrals, posited obliquely, their diameter from each other, on separate tubercles fore-tubercle stoutest.

Legs, femoral joints dark-lake, clouded, especially hind pairs; other joints yellowish; patellæ somewhat suffused

with brown; tibiæ and metatarsi have three brownish annulations, tarsi two; legs rather slender; hairs sparse; spines yellowish, dark base; tibial spines of first pair less than breadth of article in length.

Palpi have the brownish tints of legs, digital joint fairly armed with hairs and spines.

Falces red mahogany-colour; conical, vertical, project at base in front, about equal to the pars femoralis of a leg of first pair in stoutness.

Maxillæ dark-brown, yellowish apices; broad-spathulate, width nearly equals length, moderately inclined towards each other.

Labium colour of maxillæ; large, nearly as long as broad, roundly pointed.

Sternum glossy, brown-black; few white hairs; cordate, rugulose, eminences opposite coxæ.

Abdomen somewhat of a broad-ovate, rather depressed above; humeral and posterior tubercles slightly developed, latter consist of five in normal position; few white hairs chiefly on base; folium moderately acute-crenate; light-brown, dark narrow border, numerous small brown spots, and creamy-coloured flecks with a purple centre; between the two fore-pairs of impressed spots is a brown broad-lanceolate figure, spotted and bordered with a deeper tint, connected with a similar but smaller and more irregularly-shaped mark above the anterior pair of spots; this mark is followed by a dark oval spot; from the latter a rather narrow irregular band curves round base of abdomen; lateral margins have the normal spots and flecks; a brown, undulating, horizontal streak somewhat divides the chocolate-brown superior zone from the lower lighter-toned parts; ventral surface light-brown; obliquely corrugated, corrugations streaked with black-brown; shield olive-tinged slate-colour, bordered with flecks of a paler tint, each lateral fleck encloses a small depression; shield tumid between branchial opercula; a series of eight pits form a V-shaped figure in centre. *Corpus vulvæ* yellowish; cucullate, transversely wrinkled, fore-margin of cucullus involute, centrally drawn out into a brownish, transversely rugose scapus; wrinkles extend across margins, which are only moderately tumid; length of scapus vulvæ equal to the reddish stilis.

Single example, Waiorongomai Gorge, *A. T. U.*

Epeira albi-scutum, sp. nov.

Female.—Ceph.-th., long, 4; broad, 4; facial index, 1·8. Abd., long, 6; broad, 5. Legs, 1, 2, 4, 3 = 15·5, 14·5, 13, 8 mm.

Cephalothorax yellowish-brown, tinged with olive-green;

caput and lateral margins clouded with chocolate-brown; rather sparsely clothed with light hairs; length scarcely equals the patella and tibia of a leg of 4th pair; sides well rounded; lateral constriction at caput moderate; pars cephalica somewhat depressed, roundly truncated, eye-eminence moderately prominent, facial index less than one-half breadth of thorax, lateral index equals space between posterior lateral eyes; median indentation on pars thoracica deep; radial striæ faint, caput stronger; contour of profile rises with a slight curve to limit of caput, slopes to thoracic junction at an angle of 40°; depth of *clypeus* scarcely equals diameter of a fore-central eye.

Posterior row of *eyes* recurved, median pair nearly an eye's breadth apart, rather more than a diameter's interval from anterior centrals, divided from lateral eyes by their space and a quarter; anterior row recurved; centrals about equal to hind pair in size, rather further from each other than they are from posterior pair, nearly their space from side-eyes; laterals about one-third smaller than centrals, seated obliquely, perceptibly more than their radius from one another, on moderate tubercular prominences.

Legs moderately strong; yellowish, femora suffused with lake-chocolate; patellæ brown; annulations on two first pairs scarcely perceptible; tibiæ of hind pairs have two broad, somewhat confluent, chocolate-coloured rings; annulations on metatarsi less pronounced; hairs light-yellow; spines on femoral, genual, tibial, and metatarsal joints rather long and numerous, yellow.

Palpi yellow; hairs sparse; spines slender; length 4·2 mm.

Falces yellowish, clouded with olive-green; conical, moderately gibbous in front, inwardly inclined.

Maxillæ, fore-end dilated, somewhat pointed, inclined towards *labium*, which is rather broader than long, pointed, everted; organs dark chocolate-brown, yellowish apices.

Sternum cordate, eminences opposite coxæ; dark chocolate-brown, median streak yellow.

Abdomen broad-oviform, somewhat angular, projects over base of cephalothorax, humeral processes moderately developed; dorsal shield creamy-yellow, few lake spots; hairs white, sparse; base somewhat angular, tapers to spinners; four impressed spots form a trapezoid narrowest in front; lateral margins yellow-brown, clouded with brown, except the upper part of basal end, which is a blackish chocolate-colour; sparsely clothed with dark hairs, few bristles; dash of red-lake on ventral surface, shield dark-green bordered with creamy-yellow. *Corpus vulvæ* represents a transversely-wrinkled, glossy, dark amber-coloured hood, drawn out into a broad scapus, margined with a wide elevated beading; about as broad

across curvature as long, compressed a little forwards, terminates with a rather shortly-articulated calceolate apex.

Te Karaka, *A. T. U.*

Epeira dubitabilis, sp. nov. Plate XVII., fig. 3.

Male.—Ceph.-th., long, 3; broad, 2·7. Abd., long, 3·3; broad, 3. Legs, 1, 2, 4, 3 = 15, 13, 9·7, 7·6 mm.

Cephalothorax light olive-tinted brown; moderately clothed with light-yellowish hairs; depressed, sides rounded; facial index 1mm., lateral index scarcely equals one-half former; ocular prominence moderate; thoracic indentation longitudinal; caput and radial striæ slight; contour of profile represents a low arch; depth of *clypeus* about equal to radius of a fore-central eye.

Fore and hind rows of *eyes* recurved; posterior centrals about an eye's breadth from each other, divided by rather more than that interval from fore-median pair; perceptibly more than their space from lateral eyes of same row; anterior centrals rather further from one another than they are from posterior pair, which they equal in size; lateral eyes smaller than centrals by one-half, posited obliquely, less than their radius from one another, on tubercular eminences; fore-tubercle strong.

Legs brownish-yellow, femora of first and second pairs mostly suffused with a deeper shade; two broad, somewhat faint, annuli; patellæ reddish-brown; two faint annulations on tibiæ; shading on the femora of third, more especially fourth pair, reddish-mahogany colour, rings olive-brown; patellæ suffused; more or less defined annulations on tibial and metatarsal joints; legs moderately stout; pars tibialis cylindrical; hairs whitish, sparse; femora of first and second pairs have, besides a few spines on superior surface, a cluster of about 13 long spines beneath; few spines on the patellar joints; tibiæ have respectively 15 + 12, exceeding diameter of articles in length; 6 on metatarsi; thighs of posterior pairs sparsely armed on superior surface; 4 on patellæ; about 7 + 10 on tibial, 7 + 11 spines on metatarsal joints.

Palpi yellowish; humeral joint exceeds cubital and radial in length; pars cubitalis broad-oval, flattened above, projects in front two long bristles; pars radialis produced on outer side into a large, depressed, somewhat conical, downward-directed process, projecting a short conical spur near its base on inner side; pars digitalis large, lamina bulbi yellowish, tinge of olive-green; oval, base produced into a stout somewhat conical process, 2·5mm. long, nearly as broad at base as long, curved slightly backwards; prolonged on outer side into a strong, curved, lake-brown apophysis; border beneath the yellowish semi-globose cap of bulbus genitalis chocolate-

brown; tumid, vertically rugulose, fore-part developed into a stout backward-curved process; projecting downwards from within concavity of bulbus are four appendages; the basal is blackish-lake, broad, bifurcate, convex on posterior side; central process yellowish, pointed-oval, concave in front; anterior appendage black-lake, broad, curved backwards; just in front of the central process is a stout up-curved projection; springing from near base of the central process, and curving round its apex, is a moderately long and slender semi-pellucid yellowish apophysis.

Falces flavescent, suffused with olive-brown; vertical, somewhat conical, rather divergent at apex.

Maxillæ fulvous, base suffused with olive-green; about as broad as long, rounded; projects at extremity, on outer side, a brownish, stout, conical process; inclined towards *labium*, which is broader than long, pointed; fulvous, base olive-green.

Sternum chocolate-brown, yellowish-green oblong figure in centre; cordate; eminences opposite coxæ.

Abdomen depressed above, base pointed, tapers posteriorly from humeral processes, which are slightly developed; sparsely clothed with light hairs; ground-colour dark-brown; an undulating, creamy-coloured, purple-spotted band, connecting the humeral processes, encloses anterior pair of impressed spots; prolonged on fore-side into a broad, olive-green, spotted petiole curving round base; on posterior side of transverse band are five olive-green, purple-spotted, somewhat irregularly-shaped transverse bars; anterior bar, angular, marked with a few pale flecks, connected at apex with humeral band; third, fourth, and fifth bars have creamy-coloured, purple-spotted patches increasing in breadth; shield on ventral surface black, margins undulating.

Single example, captured on *Leptospermum*, Bluff, Otago, *A. T. U.*

Epeira tri-notata, sp. nov.

Male.—Ceph.-th., long, 4; broad, 3. Abd., long, 5; broad, 3. Legs, 1, 2, 4, 3 = 18·5, 16, 12, 9 mm.

Cephalothorax, sides lightly suffused with olive-brown; median band pale raw-sienna, broad, undulating, equals eye-area in breadth; a lake-coloured streak runs forwards in a slight groove from thoracic fovea, radiates at base of caput; few fine yellowish hairs on thoracic part; broad-oval; lateral margins of caput fairly constricted; pars cephalica somewhat depressed, limited by an indentation; ocular eminence rather broad and prominent; pars thoracica moderately convex, fovea rather shallow; radial and caput striæ faint; profile-line represents a low, rather even arch; height of *clypeus* visibly exceeds the diameter of a fore-central eye.

Posterior row of *eyes* perceptibly recurved, median pair visibly smaller than fore-centrals, seated on black, oval spots, slightly over an eye's breadth apart, their space and one-third from laterals of same row; anterior row moderately recurved, centrals on black rings, rather closer to hind pair than they are to one another, an interval equalling their diameter and one-half; two-thirds their space from side-eyes; laterals posited obliquely on low, blackish, tubercular eminences, separated from each other by an interval surpassing their radius.

Legs fulvous, fore-end of femoral joints of first and fourth pairs have a raw-sienna tinge, limited below spines by a broken, on outer side, olive-green ring; this shading resolves itself on the second pair into two, and on the third one broad ring, faint on outer side; patellæ have two annuli; tibiæ and metatarsi have central and apical rings, somewhat obliterated on latter articles; legs rather slight; coxæ of first pair project a short curved process; tibiæ cylindrical; hairs sparse, light; femora of first pair have 10 spines on superior surface, 21 on inferior side; latter spines longer and stronger than those of second pair, which are armed with 12 above, 16 below; patellæ 5; tibial joints of two first pairs about 20 spines, not much surpassing diameter of articles in length; metatarsi about 10; femoral joints of third pair about 15; patellæ 5; tibiæ 15; metatarsi 7; femoral joints of fourth, about 5 on superior surface, 15 mostly strong spines beneath; tibiæ 13; metatarsi 9.

Palpi fulvous; humeral joint rather exceeds cubital and radial together in length; former article—viewed from above, somewhat ovate—projects in front two long strong bristles; radial joint short, cupuliform, produced on outer side into a stout somewhat triangular process, longer than broad; pars digitalis large, somewhat globose; lamina bulbi brownish tinge, few whitish hairs; oval; base produced into a slightly-curved conical prominence, directed towards falces; prolonged outwardly into rather broad, curved, red-brown process; bulbus yellowish; projecting from within the partially-cleft crown is a reddish-brown, semicircular, tongue-like lobe; most remarkable appendages—near base, directed downwards and slightly backwards, is a brownish, dark-margined, elongate, horny lamellar process, whose inner fore-angle is prolonged and curved; in front of latter organ is a pale-yellow lamellar process of about equal length, curved forwards, apex dilated, rounded, emarginate; beneath a sharply-tapering inward-curved lobe, representing the frontal line of bulbus genitalis, is a pale broad membrane, tapering into a blackish apophysis, curving backwards to the above-mentioned organ; projecting inwardly from near base of membraneous appendage is a

moderately long flattish process, fore-half blackish-brown, constricted.

Falces and cephalothorax concolorous; somewhat conical and divergent, vertical.

Maxillæ yellowish, base lightly suffused with brown; rather longer than broad, rounded; inclined towards *labium*, this organ has an olive-brown tinge, apex pale; breadth rather surpasses length, pointed, everted.

Sternum yellowish; cordate.

Abdomen oviform, moderately convex above; hairs light, very sparse; suffused with creamy-coloured purple-tinted flecks, spotted and bordered with purple; folium grey shade, margins acute-crenate, posterior side of crenatures bordered with brown; above, and in contact with anterior pair of impressed spots, is a large, creamy-white, purple-margined, elliptical transverse figure, centrally intersected by a purple line; between this line and the above-mentioned spots the figure is prolonged into two short conical projections; a series of moderately large spots of normal colour, but of unequal size, form a transverse row in front of elliptical mark; extending backwards from the second pair of impressed spots is a figure of nearly equal size and similar coloration as the anterior mark, pointed at either end, centrally constricted; slightly removed from its posterior apex is a moderate-sized transverse oval spot, of normal colours; ventral surface light stone-brown; shield slaty-brown, margins thickly flecked with dull-white.

Captured up the Waiorongomai Gorge, Te Aroha, *A. T. U.*

Var. *olivinia*, var. nov.

Colour and markings of *cephalothorax*, *legs*, and *palpi* have a deeper tinge than obtains in *E. tri-notata;* folium and lateral margins of *abdomen* do not differ essentially from the above-mentioned species, except that they have an olive-brown colour, and the former is comparatively darker. (Probably fresh specimens would have purple tints.) The basal creamy-white (elliptical) figure is divided by a rather broad line, represents two somewhat reniform leaf-like marks; the conical projections are in this variety prolonged into short petioles, curving round the impressed spots; the central mark less constricted, fore and hind extremities rounded; posterior spot smaller, and separated by a wider interval from the central mark.

This interesting specimen was contained in *Mr. T. Kirk's* Wellington collection.

Epeira mulleola, sp. nov.*

Male.—Ceph.-th., long, 4·5; broad, 4. Abd., long, 4·7; broad, 4. Legs, 1, 2, 4, 3 = 16, 14, 13, 9 mm.

Cephalothorax light chestnut-brown; margins suffused with olive-brown; hairs whitish, somewhat sparse; pars cephalica depressed; central indentation somewhat quadrilateral; pars thoracica moderately convex, indentation cruciform, red chestnut-colour; profile-contour arched across thorax, slopes forward.

Eye-eminence prominent; anterior centrals rather exceed posterior pair in size, form with them a quadrilateral figure broadest in front; lateral eyes separated by an interval equalling their radius, posited obliquely on tubercular prominences; fore-tubercle prominent.

Legs yellowish, femoral joints shaded with chocolate-brown on superior surface; brownish annuli on tibial, metatarsal, and tarsal joints; tibiæ of second pair stouter than same article of first pair, armed with stronger spines; pars tibialis of first pair rather slender, somewhat incrassated at fore-end, spines exceed diameter of article in length; coxal joint projects a short, curved, reddish process.

Palpi yellowish-brown; humeral joint about twice length of cubital; latter article broad-spathulate, projects a long strong bristle at apex; radial joint prolonged downwards, on outer side, into a somewhat spathulate, light-yellow process; pars digitalis large, broad-oval; lamina ovate, apex curved downwards; base produced into a curved, lake-coloured process, laminæ directed towards each other; moderately hairy; yellow-brown, clouded with olive-green; genital bulb complex—most conspicuous organs in front; and directed backwards is a bright orange-red oval process; between latter process and a large, bifurcate, blackish appendage, is a somewhat cordate yellow-brown process surpassing former in size.

Falces long, somewhat slender, concave on outer side; yellowish, clouded with olive-green.

Maxillæ nearly as broad as long, somewhat pointed, inclined towards *labium*, this organ is nearly as large as maxillæ, similar coloration, chestnut-brown, pale apices.

Sternum cordate; chocolate-brown; few white hairs.

Abdomen moderately angular in front; slaty stone-colour; folium stone-colour, resembles female somewhat in form and markings; on lateral margins are rather obscure interrupted streaks of a dark-brown colour; ventral shield greenish-black, margins yellow.

Te Karaka, *A. T. U.*

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* Female described and figured in "Trans. N.Z. Inst.," vol. xx., p. 118.

Gen. **Tetragnatha,** Latr.

Tetragnatha typica, sp. nov. Plate XVII., figs. 6 and 7.

Female.—Ceph.-th., long, 4·5; broad, 2·8. Abd., long, 10; broad, 4. Legs, 1, 2, 4, 3 = 34, 23·5, 22·5, 10 mm.

Cephalothorax light sienna-brown; median band broad, tapers from occiput to base of thorax, chocolate-brown; lateral margins and striæ similar colour; nearly glabrous; oval, lateral constriction at caput slight; pars cephalica depressedly convex; ovate central indentation; eye-eminence moderate, somewhat conical; facial index rather more than one-half breadth of pars thoracica; latter depressed, displays two deep narrow-ovate indentations, apices converge forwards to limit of caput; radial striæ faint; contour of profile slopes moderately backwards to thoracic indentation, displays posteriorly an obtuse conical prominence; *clypeus* inclined perceptibly inwards, depth about equal to diameter of a fore-central eye.

Posterior and anterior rows of *eyes* moderately recurved, former rather the shortest; median eyes of hind row perceptibly closer to one another than they are to laterals; rather smaller than fore-centrals, visibly larger than side-eyes of their own line; anterior median pair seated obliquely on an eminence, perceptibly more than an eye's breadth apart, rather more than that interval from hind pair, with which they form a trapezoid, narrowest in front; lateral eyes posited on low, black, tubercular eminences, interval between them nearly equals that between fore- and hind-centrals; posterior pair visibly the largest.

Legs fulvous; slender; hairs fine, sparse, yellowish; few bristle-like spines on femora, patellæ, tibiæ, and metatarsi; superior tarsal claws moderately curved—first pair, 13 close comb-teeth, increasing somewhat in size; inferior claw rather long and strong, 2 close teeth.

Palpi colour and armature of legs; palpal claw well-curved, 15 comb-teeth, increasing in size.

Falces yellow mahogany-colour; equal cephalothorax in length; cylindrical, strongly pronected, divergent, beneath fore-extremity on outer side is a rather strong tooth-like process; 9 teeth in superior row, increasing somewhat in size, third tooth from fore-end rather the longest; inferior row 11 teeth, second, third, and fourth from apex rather the weakest.

Maxillæ yellowish-brown; long, linear, apex rounded and somewhat enlarged on superior side, moderately divergent.

Labium chocolate-brown; everted apex yellowish; conical, base collar-like; more than one-third length of maxillæ.

Sternum yellowish-brown; cordate.

Abdomen somewhat cylindrical, tapers posteriorly, base

emarginated; hairs fine, sparse; dorsal figure chocolate-brown; somewhat lanceolate, sinuate; encloses a light-brown mark, speckled with yellowish-white, basal half conforms somewhat to outer sinuations, posterior half tapers rapidly; two brown lines, curving obliquely backwards, spring from the constriction in the dorsal pattern above its greatest width; lateral margins display broad, thickly-flecked, sinuate bands; upper third forms a yellowish-white border to the median figure, shades off to a light-brown beneath; ventral surface dark-brown. *Corpus vulvæ* represents a narrow semicircular hood; brownish, margins light; projecting backwards from within is a broad-conical (relievo) brown eminence, furnished with a few short black hairs.

Cephalothorax and legs in some examples have a dark amber-colour.

Male.—Ceph.-th., long, 4; broad, 2·5. Abd., long, 8; broad, 2. Legs, 1, 2, 4, 3 = 33, 28, 22, 10 mm.

Cephalothorax yellow-brown, suffused above with red-mahogany; thoracic radii streaked with a similar colour; lateral border dark-brown; hairs light, very sparse; oval, slightly constricted forwards; pars cephalica depressedly convex, eye-eminence somewhat conical, moderately prominent; facial index rather exceeds one-half breadth of thorax, which is somewhat depressed; indentation resembles female, normal grooves slight; profile-line represents a moderate curve across occiput, caput slopes slightly into fovea, arched behind; depth of *clypeus* rather exceeds the diameter of a fore-central eye.

Legs brownish amber-colour; pars femoralis and tibialis of first pair of equal length, rather shorter than penultimate article; armature fine hairs; about 9 slender bristle-like spines on femora of two first pairs; 4 + 6 on third and fourth; 1 spine on patellæ; 6 on tibiæ of first and second; 3 + 7 on tibial joints of third and fourth pairs; 3 on metatarsi of two anterior pairs; 5 + 3 spines on latter joints of hind pairs.

Palpi and legs concolorous; slender; pars humeralis about one-fourth longer than cubital and radial joints together; former article shortest by one-fourth; fore-end of radial joint somewhat incrassated; digital joint equals radial in length; lamina beneath bulbus, furnished with long hairs; basal half (rather less) folds round base of clava, forming a cleft cup-shaped receptacle for the bulbus genitalis; fore-half sharply constricted, narrow, linear, apex obliquely truncated; a long, somewhat ear-shaped lamellar process, projecting forwards beyond the bulb, springs from the base of palpus clava, on its inner side, at the cleft in lamina; the bulbus represents a flattened sphere resting in the cup of lamina; of a yellowish

colour, zoned by a broad callus; within the somewhat depressed fore-end of bulbus is a stout, spiral, reddish-brown process, whose free end extends rather beyond apex of the lamina bulbi.

Falces mahogany-brown; equal cephalothorax in length, strongly porrected, divergent, fore-end somewhat incrassated; projecting from apex on upper side is a strong, tooth-like process, with a small blunt tooth on fore-half; superior row of teeth consists of 7 small teeth increasing in size, and 2 stout teeth close to base of fang, posterior tooth strongest; inferior row, 9, increasing in strength, 2 strong teeth near apex.

Maxillæ yellow-brown; long, somewhat enlarged on superior side, apex rounded.

Labium chocolate-brown, yellowish margin; conical, everted.

Sternum chocolate-brown; cordate.

Abdomen, coloration and pattern somewhat resemble the female, shade darker.

This species is rather common in the Auckland District; frequents rushy swamps. About March the female attaches to some object near her snare a subglobose, sometimes rather conical cocoon, about 5mm. in diameter, of a light, loose texture, whitish-brown, with greenish-brown tufts; the eggs are nearly spherical, and of a pale-brown colour, about 95 in number, agglutinated together into a subglobose mass.

Examples of this species were communicated to me by *P. Goyen, Esq.*, of Dunedin, and *Mr. T. Kirk's* Wellington collection also contained specimens.

Tetragnatha herbigrada, sp. nov.

Male.—Ceph.-th., long, 3·3; broad, 2·8. Abd., long, 5; broad, 2. Legs, 1, 2, 4, 3 = 36, 21, 15, 10 mm.

Cephalothorax brownish-yellow, median band, which tapers from hind row of eyes, clouded with olive-green, sides are lightly speckled and margins bordered by a narrow streak of similar colour; hairs pale, fine, very sparse; oval, fairly compressed forwards; pars cephalica slightly convex above; facial index equal to nearly one-half breadth of cephalothorax; lateral index equals two-thirds of facial; pars thoracica moderately convex, fovea oval, deep; normal grooves rather slight; profile-contour represents a somewhat even low arch; *clypeus* retreats perceptibly, height scarcely exceeds the diameter of a fore-central eye.

Eyes on black spots; posterior row sensibly procurved—nearly straight; centrals nearly an eye's breadth from each other; rather more than that interval from side-eyes; anterior row recurved; centrals posited on a moderate prominence, slightly exceed hind median pair in size; separated from one

another by an interval rather exceeding their radius, and from posterior centrals by more than their diameter; lateral eyes scarcely two-thirds size of fore-centrals, seated obliquely, nearly contiguous, on separate, low, black, tubercular eminences.

Legs brownish-yellow, two or three more or less defined reddish-brown annulations; femora of first and second pairs darkest; long, slender; armature, fine erect hairs, few long slender spines on femoral, genual, tibial, and metatarsal joints.

Palpi light brownish-yellow; coxa long, more than half length of humerus; latter joint nearly twice length of cubital and radial together; penultimate joint nearly twice length of pars cubitalis, base rather slender, breadth at fore-end scarcely equal to one-half its own length; furnished with hairs; pars digitalis somewhat disciform, laminæ broad, somewhat pyriform, moderately hairy, directed towards each other; base of lamina, on upper side, produced into a broad, short protuberance projecting at each angle a short, curved process; a wide, reddish-brown, transverse band is prolonged above into a moderately long curved process; bulbus genitalis spiral, free end curved downwards and forwards, stout, about equal to diameter of bulb in length; springing from beneath base of the free end is a long, fine, black apophysis, which curves round the margin of bulbus to apex of free end.

Falces reddish-brown; stout, prominent at base in front, moderately divergent; length equal to coxa of a leg of first pair, transversely rugulose.

Maxillæ olive-tinged light chocolate-brown; long, strong, divergent, and enlarged at extremities, rounded on inferior side.

Labium dark chocolate-brown, pale apex; nearly as long as broad, everted; transverse indentation; less than half length of maxillæ.

Sternum light chocolate-colour, narrow brown border; cordate, eminences opposite coxæ.

Abdomen elongate-oval, projects over base of cephalothorax, somewhat depressed above; lateral margins rugulose; fulvous, sides suffused with pale golden flecks, those especially bordering median band reflecting a metallic lustre; fore-half of dorsal band somewhat oval, border undulating; posterior half moderately constricted, margins acute-crenate; more or less obliterated above spinners; olive-brown suffused with metallic flecks; encloses a greenish-yellow, elongated, tapering figure, which has a somewhat transverse oval form between the anterior pair of (red) impressed spots; posteriorly it throws off a series of three angular streaks, one at each pair of

impressed spots. Ventral surface displays a yellowish-green elongate-oval figure bordered with metallic flecks, extending from the branchial opercula to spinners; latter brownish, short.

Var. a.—*Cephalothorax* and *legs* shade darker. *Abdomen* dark olive-brown, lightly suffused with lake; interrupted wavy lake-coloured lines intersect the more or less pale-yellowish flecks bordering median band.

Female.—Ceph.-th., long, 3; broad, 2. Abd., long, 3·8; broad, 2·5. Legs, 1, 2, 4, 3 = 23, 14, 11·2, 7 mm.

Cephalothorax fulvous, median band suffused with olive-green; tapers posteriorly from hind row of eyes, defined on caput by a dark streak; sides suffused with similar tinge, border dark; hairs fine, sparse; oval lateral constriction at caput moderate; pars cephalica depressedly convex, facial and lateral index of nearly equal length; pars thoracica convex, fovea large, deep, longitudinal oval; radial striæ faint, caput grooves stronger; profile-contour rises at an angle of 10° across caput, dips to thoracic junction at an angle of 50°; *clypeus* inclined inwards, height about equals diameter of a fore-central eye.

Posterior row of *eyes* sensibly procurved—nearly straight; median pair on dark spots, perceptibly smaller than fore-centrals, separated from one another by rather less than their diameter, more than an eye's breadth from side-eyes; anterior row recurved, centrals posited on a dark moderately prominent eminence; interspace between them scarcely exceeds their radius, separated by rather more than an eye's breadth from hind pair; laterals rather smaller than posterior-centrals, seated obliquely on separate black tubercles, nearly contiguous.

Legs and cephalothorax concolorous; femoral joints have three-fourths of basal end lightly suffused with olive-brown, dark rings near apex; broad ring on patellæ; tibiæ and metatarsi three annulations; legs slender; armature fine erect hairs, slender spines on all joints except tarsi; superior tarsal claws, first pair long, slightly curved, 11 close teeth, increasing somewhat in strength; inferior claw 2 teeth, free end curved, apex forwards.

Palpi colour and armature of legs; palpal claw long, moderately curved, 7 close teeth, irregular in strength.

Falces yellowish-brown, clouded, apices red-chestnut; somewhat conical, gibbous in front, divergent, inclined sensibly inwards, length equal to the patellar joint of first leg.

Maxillæ brown, clouded with dark-brown; long, apex rounded, enlarged on superior side, divergent.

Labium darker than maxillæ, less than twice as broad as long, roundly pointed, transverse groove.

Sternum chocolate-brown; broad-cordate, eminences opposite coxæ.

Abdomen elongate-oval; sparsely clothed with fine hairs; dorsal figure lightish-brown, clouded with olive-brown, margins black-brown; flecks dull greenish-yellow or metallic; fore-third somewhat oval, margins undulating; posteriorly constricted to nearly one-half its greatest breadth; constricted part displays two pairs of angular projections, fore-pair short, obtuse, hind pair acute, prolonged; lateral margins olive-brown, oblique dark-brown streak on basal end; flecks dull greenish-yellow with slight metallic reflections; border of creamy-coloured flecks round margin of dorsal figure; ventral surface brownish. *Corpus vulvæ* mahogany-brown; semi-oval projection, slightly convex, large, about as deep as broad across at base.

Examples of this species, especially the males, were not uncommon amongst the damp vegetation about the water-courses up the Waiorongomai Gorge, Te Aroha. Individually they differed somewhat in coloration and markings. *A. T. U.*

Fam. THERIDIIDÆ.

Gen. **Theridium**, Walck.

Theridium zebrinia, sp. nov.

Female.—Ceph.-th., long, 2. Abd., long, 3·5. Legs, 1, 4, 2, 3 = 13·1, 13, 11·5, 5 mm.

Cephalothorax, facial space and median surface yellow-brown, sides and oblong figure extending from fovea to posterior row of eyes olive-brown; glabrous; oval, lateral constriction forwards slight; pars cephalica flatly convex, roundly truncated, lateral index short; pars thoracica depressed; indentation transverse, normal grooves moderately defined; contour of profile represents two low curves; *clypeus* convex, indentation below eyes, projects forwards, depth rather exceeds one-half facial space.

Eyes of moderate and about equal size, on dark rings; posterior row slightly recurved; centrals rather further from each other than they are from laterals of same row; anterior row recurved, median pair separated from one another by an interval perceptibly exceeding an eye's diameter; less than that space from side-eyes, and more than their breadth from posterior centrals; laterals have the pearl-grey lustre of hind median eyes, posited obliquely on low tubercular eminences; nearly their diameter apart.

Legs light yellow-brown, patellæ light-brown; annuli at articulation of all joints have a similar hue; rings more pronounced at extremity of tibiæ; armature, sparse fine hairs.

Palpi colour and armature of legs.

Falces light chestnut-brown; conical, nearly vertical.

Maxillæ yellowish; linear-oval, inclined towards *labium*; this organ is brownish-yellow; oval, broader than long, equal to two-thirds the length of maxillæ.

Sternum olive-green, brownish median streak tapers from lip; triangular.

Abdomen oviform; mottled stone-grey; the grey and black, elongate, somewhat serrated folium encloses a yellowish rather broad median band, posterior half undulating; fore-half constricted, represents two somewhat diamond-shaped figures; lateral margins display a series of four dark-grey rib-like streaks, confluent with folium and black ventral surface; shield stone-grey, somewhat quadrate, lateral margins acutely emarginate; yellowish spot on either side of spinners. *Corpus vulvæ* light-brown; simple semi-cylindrical, longitudinal elevation, orifice wide.

Single specimen, *Mr. T. Kirk's* Wellington collection.

Theridium pusillulum, sp. nov.

Female.—Long, 1·7mm. Legs, 4, 1, 2, 3.

Cephalothorax glossy, cephalic parts dark-brown, suffused with black; thorax light-brown, semi-pellucid; marginal band slate-colour; median streak paler shade; few black hairs on caput; clathrate; oval, fairly constricted forwards; pars cephalica convex; eye-eminence broad, projects moderately forwards; pars thoracica convex, fovea large, shallow; normal grooves moderately defined; contour of profile represents an obtuse angle; *clypeus* directed forwards, depth more than equal to one-half facial space.

Posterior row of *eyes* procurved; centrals separated by an interval equal to an eye's breadth and a quarter, perceptibly more than that space from fore-centrals; about twice their diameter from side-eyes; anterior row recurved; median pair rather larger and further apart than are the hind pair; laterals equal posterior centrals in size, have their pearl-grey lustre, posited obliquely on low tubercular eminences, contiguous.

Legs rather strong, moderately long; pale-yellowish stone-colour; fore-half of femora, tibiæ of first and second pairs, and tibiæ of metatarsi, and tarsi of third and fourth, have an orange-brown tinge; armature, coarse black hairs, few erect bristles.

Palpi colour and armature of legs.

Falces yellowish, slight olive-green tinge; somewhat conical, short, equal to about two-thirds depth of clypeus, directed slightly forwards and outwards.

Maxillæ elongate-oval, curve over labium; yellowish-brown. *Lip* chocolate-brown; semi-circular.

Sternum brownish stone-colour, margins dark; broad-cordate.

Abdomen oviform, convex, projects over base of cephalothorax; somewhat sparsely clothed with short hairs; light-brown, dorsal surface suffused with dark-brown; basal half displays a conspicuous dark-brown Maltese cross, with a rather broad pinkish border, latter prolonged as a moderately wide undulating band to spinners. Ventral surface semi-pellucid slate-colour. *Corpus vulvæ* brown; represents a small truncated cone, orifice at apex; on posterior side is a tumid lip, extending laterally rather further than base of cone. The light-brown branchial opercula placed somewhat close together; in contact with vulva.

Single example, Te Karaka, *A. T. U.*

*Theridium sericum,** sp. nov. Plate XVII., fig. 2.

Male.—Ceph.-th., long, 4; broad, 3. Abd., long, 5; broad, 3. Legs, 1, 4, 2, 3 = 19, 17, 15, 12 mm.

Cephalothorax red-chestnut colour; glabrous; broad-oval, lateral constriction at caput rather slight; pars cephalica depressed, sides somewhat abrupt; pars thoracica convex, fovea nearly circular, deep; caput and radial striæ well-defined; profile-line represents posteriorly a moderate angle, curved slightly across base of caput, rising perceptibly to hind row of eyes. *Clypeus* convex, projects forwards, length rather less than two-thirds depth of facial space.

Anterior row of *eyes* moderately recurved, central pair rather the smallest and darkest of the eight; separated from each other by an interval equal to about three-fourths their diameter, rather less than that space from laterals of same row; posterior row perceptibly procurved, median pair somewhat oval, rather further from side-eyes than they are from one another, a space scarcely equalling their shortest diameter; laterals hardly equal hind centrals in size, have their pearl-grey lustre; posited obliquely, nearly contiguous, on low tubercular eminences.

Legs fulvous, coxæ and base of femora tinged with reddish brown; rather slender, first and fourth pairs somewhat the stoutest; armature, fine black hairs, few slender bristles.

Palpi and legs concolorous; humeral joint one-fourth longer than cubital and radial together; former article viewed from above somewhat oval, scarcely wider than pars humeralis, projects two long bristles; radial joint rather longer than broad at fore-end, tapers to base; slightly exceeds cubital in length; digital joint surpasses two former articles in length; lamina ovate, somewhat elongated, pointed; bulbus

* Female described in "Trans. N.Z. Inst.," vol. xviii., p. 198.

reddish-brown, viewed from beneath spiral; free end long, basal half broad, concave above, tapers forward into a fine black apophysis, which partially encircles the stone-grey truncated apex of genital bulb; this greyish area displays two short, conical, brown eminences; attached just above these eminences, and projecting forwards in contact with the lamina, is a remarkable milky-white, membranous, somewhat spindle-shaped process.

Falces rich red chocolate-colour; somewhat conical; profile convex, fore-half inclined inwards.

Maxillæ reddish-chestnut, pale apices; linear, pointed, much inclined over *labium*, which is nearly as long as broad, pointed; mahogany-brown.

Sternum red-chestnut; broad-cordate; covered with small papillæ, projecting black hairs.

Abdomen oviform, convex above; hairs fine, sparse; ground-colour light stone-brown; base and lateral margins marked with numerous vertical and horizontal purple-brown dots and dashes; dorsal field displays a series of four purple-brown, recurved, undulating bands, decreasing in width from fore-end; four anterior impressed spots, which are large and of a reddish colour, occur on the first and second bands; ventral surface stone-brown, light margins.

Males of this species apparently rare. Te Karaka, *A. T. U.*

Gen. **Latrodectus**, Walck.

Latrodectus katipo, var. *atritus*, var. nov.

Cephalothorax, *legs*, and *palpi* brown; shade darker than type-form.

Abdomen black.

A female specimen of this new *Latrodectus* was handed over to me for determination by Mr. T. F. Cheeseman. The chief difference between it and *L. katipo* is the absence of the red median stripe on the abdomen.

On referring to Mr. C. H. Robson — who first brought the variety under notice—he stated that he first found the spider in 1882, on the north end of Portland Island, off the Mahia Peninsula, Hawke's Bay. The natives assert that the variety is also to be found on the Mahia; but Mr. Robson never met with examples here himself: apparently its range is limited. The localities it affects, its habits, cocoon, and eggs resemble those of *L. katipo*; "and the young are marked exactly like the young of that species." Mr. Robson further states, "but out of hundreds of mature specimens which I have examined not one had a trace of the red dorsal stripe, so distinct a feature in *L. katipo*."

The variety is known to be venomous. When bitten the

natives apply a fire-stick to the wound. Mr. Robson states that "a man engaged in erecting the lighthouse was bitten on the neck, and went quite mad for some time."

Fam. THOMISIDÆ.

Gen. **Stephanopis**, Cambr.

Stephanopis angulatus, sp. nov.* Plate XVII., fig. 8.

Male.—Ceph.-th., long, 3; broad, 2·3. Abd., long, 3·5; broad, 2·5. Legs, 1, 2, 4, 3 = 14·4, 12·5, 7·5, 6 mm.

Cephalothorax yellow-brown, lake-coloured vein-like streaks; short, black, lanceolate dorsal mark, directed forwards from fovea; hairs sparse, short, papilliform, orange-colour; broad-oval, sharply compressed forwards, depressed; caput projects forwards; median ridge slight; normal grooves faint; contour of profile somewhat horizontal, rises at occiput, dips abruptly to thoracic junction; height of *clypeus* exceeds diameter of an eye of first row.

Posterior row of *eyes* sensibly recurved, perceptibly smaller than laterals of same row, separated from one another by rather more than the diameter of an eye, and from side-eyes by a space rather exceeding the interval; anterior row represents a recurved semicircle; median pair less than one-half size of posterior centrals, separated by twice their diameter's distance, nearly that interval from side-eyes, which are about twice the size of hind laterals.

Legs yellow-brown, speckled with lake; first and second pairs stoutest; hairs sparse, papilliform hairs yellow; femora of first pair have a few short spines; tibiæ 5–5; metatarsi 4–4; tibial joints of second pair 4–4; metatarsi 4–4; third and fourth pairs devoid of spines; tarsal claw of first pair short, stout, free and well-curved, inner claw 6 small and 1 strong terminal teeth, outer 3 coarse curved teeth; compound sessile hairs; claw-tuft exceeds claw in length.

Palpi yellowish; humeral joint rather exceeds cubital and radial together in length; pars cubitalis rather longer than broad, projects a short black bristle on inner side; pars radialis about equals former article in length but is somewhat slighter, produced on outer side into a membranous black-tipped apophysis, concave above, apex sharply constricted and curved; furnished with few bristles; digital joint rather longer than humeral; lamina large, ovate, base on outer side prolonged into a stout, pointed membranous process, convex above; furnished with few hairs; bulbus genitalis, basal two-thirds pale flesh-colour, brownish tinge; oval, diagonally trun-

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* Female described as *Sparassus angulatus* in "Trans. N.Z. Inst.," vol. xvii.

cated in front, on face of truncation is a somewhat quadrate lobe, in relievo, of a deeper hue; two black semi-detached apophyses follow the margins of the lamina, curve downwards beyond the bulb; fore-apophysis has the shortest curve.

Falces yellowish, lake stains; vertical, somewhat conical, slightly divergent, rather shorter than pars digitalis of palpus.

Maxillæ linear-conical, long, inclined toward *labium*, which is conical, more than one-half length of maxillæ; organs yellowish.

Sternum ovate; eminences opposite coxæ; few hairs; yellowish.

Abdomen aplanate above, base displays a slight angular notch; broadest between posterior subconical projections, which are directed backwards and slightly outwards; from these tubercular projections abdomen represents a triangular area dipping somewhat abruptly to spinners; sides abrupt; marginal zone longitudinally wrinkled; colour of cephalothorax, with vein-like lake-coloured streaks; blackish semicircular patch on concave margin between tubercular prominences; lateral margins and ventral surface brownish, clouded, and streaked with black-brown and lake.

Waiorongomai Gorge, Te Aroha, *A. T. U.*

Fam. LYCOSIDÆ.

Gen. **Cycloctenus**, L. Koch.

Cycloctenus lepidus, sp. nov. Plate XVII., fig. 1.

Female.—Ceph.-th., long, 4·5; broad, 4. Abd., long, 5; broad, 3. Legs, 4, 2, 1–3 = 16·5, 15·5, 14·5 mm.

Cephalothorax fulvous, markings fuscous, indentation reddish; marginal band narrow, projects across the border hem 14 acute marks, 7 on each side; radial eminences have vein-like streaks, and terminate with irregular angular marks, nearly alternating with those of the marginal band; from limit of caput two lines follow the grooves, and two broader lines radiate nearly to posterior eyes; fringe of white hairs beneath marginal zone; length equal to the patella and tibia of a leg of third pair; pars cephalica somewhat quadrate, depressed above, sides moderately abrupt; pars thoracica circular, convex, indentation narrow, longitudinal; radial and caput striæ well-defined; profile-contour rises from thoracic junction at an angle of about 50°, slightly arched to base of caput, from whence it rises with a perceptible curve to hind row of eyes, dips abruptly across ocular area; depth of *clypeus* nearly equals diameter of an eye of first row.

First row of *eyes* straight, nearly one-third size of centrals of second row, posited on a brown patch, scarcely an eye's

breadth apart, perceptibly more than their breadth from median eyes of second line; second row sensibly procurved, median pair seated on oval brown spots, perceptibly smaller than eyes of posterior row, separated from them by an interval equal to their breadth and one-half, divided from each other by a space rather surpassing their diameter, and from side-eyes—which are much the smallest of the eight—by a somewhat shorter interval; eyes of third row directed obliquely backwards, seated on rather strong black-brown tubercles, at base of which are laterals of second row.

Legs pale-brown, flesh-coloured tinge, lightly suffused with reddish-brown; about three broken, somewhat acutely-crenate, dark-brown annulations on femoral joints; rings more or less obliterated on patellæ, tibiæ, and metatarsi; faint central annuli on two latter articles; legs of nearly equal strength and length; almost devoid of hairs, except on penultimate and tarsal joints; few short black spines on femora; tibiæ of first and second pairs have 13 spines, surpassing diameter of article in length; 5–5 beneath; metatarsi 12, on inferior surface 4–4; about 8 on tibiæ and metatarsi of third and fourth; superior tarsal claws—first pair stout, well-curved, 6 open somewhat coarse teeth, increasing in length and strength; inferior claw stout, 3 open rather strong teeth, increasing in length.

Palpi colour and markings of legs; pars digitalis hairy, 13 strong spines; palpal claw, 4 very open teeth.

Falces light-chestnut; conical, project at base in front, slope inwards.

Maxillæ yellow-brown; linear, slightly pointed, about one-third longer than broad; perceptibly inclined towards *labium*, which is rather broader than long, sides rounded, apex somewhat concave, chestnut-brown.

Sternum yellow-brown; cordate, breadth nearly equals length.

Abdomen oviform, base somewhat truncated, rather depressed above; sparsely clothed with bright, straw-coloured hairs; colour of cephalothorax, spotted and figured with dark-brown; most conspicuous spots on dorsal field comprise 8 small spots on basal third, and 4 large, representing a quadrilateral figure in centre of back; few broken transverse lines towards spinners; *vulva* represents a semi-oval narrow projection, apparently simple within (organ somewhat shrunk).

Two female examples of this handsome species were contained in a collection kindly communicated to me by *T. Kirk, Esq., F.L.S.*, from Wellington.

Fam. ATTIDÆ.

Gen. **Attus**, Walck.

Attus pullus, sp. nov.

Female.—Ceph.-th., long, 2·8; broad, 2. Abd., long, 4; broad, 3. Legs, 4, 3, 1–2 = 6, 5·5, 5 mm.

Cephalothorax brown-black; rather thickly clothed, except on eye-area, with pale straw-coloured and brownish adpressed hairs, and rather long erect black hairs; *clypeus* furnished with long whitish hairs, directed obliquely forwards; elevated; pars thoracica, sides moderately rounded; about twice the length of caput; pars cephalica flatly convex above, lateral margins abrupt; contour of profile slopes forwards with a perceptible curve, dips at an angle of 40° to thoracic junction; height of *clypeus* nearly equals diameter of a lateral eye.

Anterior row of *eyes* slightly recurved; laterals perceptibly more than their breadth from centrals; latter pair two-thirds that space from each other; posterior and anterior lateral eyes of about equal size, form a quadrilateral figure one-third broader than long; eyes of second row intermediate.

Legs yellowish; first and second pairs have a red-chestnut tinge; femoral joints clouded; brown annulations—more pronounced on two hind pairs—at articulation of joints; armature, short yellowish and long black hairs; normal spines on femoral, tibial, and metatarsal joints; patella and tibia of first leg, of about equal length and strength, together equal to two-thirds length of cephalothorax; tibia three-fourths length of metatarsus.

Palpi yellowish, faint-brown rings; whitish hairs; long black bristles.

Falces red-chestnut; vertical, somewhat conical, transversely rugose.

Maxillæ, fore-end dilated and rounded; inclined towards lip; yellow-brown, base chestnut.

Labium blackish; conical, about one-half length of maxillæ.

Sternum light-brown; oval; fairly clothed with whitish hairs.

Abdomen oviform, projects moderately over base of cephalothorax; dark stone-colour, clouded with indigo-black; fairly clothed with light straw-coloured, adpressed, and erect black hairs; ventral surface brown. *Vulva* stone-colour, shaded with black; displays two oval moderately-depressed areas, surrounded by rather narrow costæ, intersected longitudinally by a septum about one-half the width of their transverse diameter; posterior two-thirds of area occupied by two reddish, dark-margined, oval foveæ.

Single specimen, taken on *Leptospermum*, Bluff, Otago, *A. T. U.*

Attus scindus, sp. nov.

Female.—Ceph.-th., long, 2·5; broad, 2. Abd., long, 3·2; broad, 2. Legs, 4, 1, 2, 3 = 5, 4·5, 4, 3 mm.

Cephalothorax red-mahogany, clouded chiefly about margins with dark-brown; hairs somewhat sparse, whitish and orange; clypeus furnished with adpressed, papilliform, yellowish hairs, and whitish vertical fringe on margin; pars thoracica moderately dilated, rather more than one-third longer than pars cephalica; latter aplanate, limited by a somewhat circular depression; profile-line slopes slightly forwards across ocular area, dips rather abruptly to thoracic junction. *Clypeus* directed visibly inwards, depth scarcely equals radius of a fore-central eye.

Anterior row of *eyes* slightly recurved; centrals perceptibly closer to one another than they are to laterals, a space visibly less than the radius of a side-eye; dorsal and fore-lateral eyes of about equal size; former rather further from each other than are the latter pair; ocular area one-third broader than long.

Legs, femoral joints of two first pairs blackish-brown; patellæ, tibiæ, and metatarsi red mahogany-colour; tarsi yellowish, dark ring; third and fourth pairs yellow-brown, dark annulations; hairs sparse, yellowish; femoral, tibial, and metatarsal joints armed with spines; first and second pairs stout; patella and tibia of a leg of first pair of about equal length and strength, together one-fifth shorter than cephalothorax.

Palpi red mahogany-colour; yellowish-white hairs.

Falces bright red-mahogany; vertical, transversely rugose; length equals the tibial joint of a leg of second pair.

Maxillæ chocolate-brown, reddish at apex; fore-end somewhat dilated, rounded.

Labium colour of maxillæ; oval; one-third length of latter organ.

Sternum dark chocolate-brown; oval; about breadth of coxal joint of a leg of second pair.

Abdomen oviform, projects over base of cephalothorax; moderately convex above; somewhat sparsely clothed with short orange-red and whitish hairs; integument yellowish stone-colour; dorsal band broad, tapers slightly forwards, dark-brown, fading somewhat behind, extends from summit of base nearly two-thirds along back; the greater area displays five spots arranged quincuncially; four transverse wrinkles above spinners, two brown spots on first wrinkle, one spot decreasing in size on each succeeding wrinkle; lateral margins

rugose, marked by a series of dark-brown, not clearly-defined, broken, oblique bands; ventral surface black-brown; transverse row of hairs. *Vulva* brown, represents a somewhat circular moderately-depressed area, bordered by a projecting yellowish costa, fore-edge of which is somewhat angular, and emarginate in centre; centrally placed are two brown foveæ, divided by a longitudinal, narrow,)(-shaped septum; between foveæ and fore-margin are two somewhat pyriform depressions, whose apices converge forwards.

Several specimens captured about the cliffs, Scinde Island, Hawke's Bay, *A. T. U.*

Gen. **Plexippus**, L. Koch.

Plexippus capillatus, sp. nov.

Female.—Ceph.-th., long, 3; broad, 2. Abd., long, 4; broad, 2. Legs, 4, 1, 2, 3 = 5·6, 5·2, 5, 4·5 mm.

Cephalothorax chocolate-brown, passing into a reddish-brown between hind eyes; hairs sparse, orange-colour; sides somewhat linear, base semi-oval; pars cephalica aplanate, slightly curved forwards, limited by a shallow oval depression; laterally abrupt; pars thoracica one-fourth longer than caput; contour of profile rises from thoracic junction at an angle of 70°, runs horizontally to posterior row of eyes, slopes moderately across occiput; *clypeus* directed inwards, depth equal to about one-third diameter of a fore-lateral eye.

Anterior row of *eyes* slightly recurved, nearly contiguous; irides orange-red, sparse; posterior pair perceptibly surpass anterior laterals in size; ocular area slightly wider in front; scarcely one-third broader than long; somewhat prominent above eyes.

Legs, first pair reddish-brown, femora tinged with olive-green; moderately stout; tibia strong, cylindrical, equal in length to the metatarsus and tarsus together; second pair stouter than third and fourth, which are of about equal strength; three hind pairs fulvous, femora tinged with olive-green; genual, tibial, metatarsal, and tarsal joints tinged with reddish-brown; fairly clothed with fine black hairs; few fine, erect bristles; 4 curved spines on femoral joints; 3–3 spines beneath tibiæ of two first pairs; 2–2 beneath metatarsi; about 6 irregular spines on tibiæ of third and fourth pairs; 2 or 3 and ring of 5 on metatarsi; superior tarsal claws—first pair, outer claw 1 stout tooth; inner claw about 14 fine, close teeth, terminating with 1 rather strong tooth.

Palpi, humeral joints yellowish, other articles reddish-brown.

Falces reddish-brown colour; somewhat of a broad-oval,

flat, transversely rugose, perceptibly inclined towards maxillæ; stout, length equals metatarsus of first pair.

Maxillæ light reddish-brown; long, spathulate, directed slightly outwards.

Labium yellowish, tinged with olive-green; oval, one-half length of maxillæ.

Sternum yellow-brown, suffused with olive-brown; ovate, widest at posterior end.

Abdomen elongate-oviform, base somewhat truncated; rather thickly clothed with adpressed, bright, light-yellowish hairs, and fine, black, erect hairs; folium stone-brown, tinged with olive-green; lanceolate; serrations fine, irregular; basal third displays a few brown spots, and an angular broken bar; from near latter mark a stone-coloured lanceolate figure, bordered by a disconnected, brown line, extends to spinners; lateral margins brown-black, somewhat longitudinally streaked; ventral surface stone-brown; shield margined and centrally intersected by brown lines, former darkest. *Corpus vulvæ* represents a reddish-brown, moderately prominent, ovate eminence; foveæ intersected by a broad septum, dilated at posterior end; a short cleft at its base, on either side, forms two angular processes, which give the foveæ a comma-shape.

Two specimens. Te Karaka. *A. T. U.*

EXPLANATION OF PLATE XVII.

Fig. 1. *Cycloctenus lepidus*, sp. nov. Female, three times natural size: *a*, eyes.
Fig. 2. *Theridium sericum*, sp. nov. Palpus of male.
Fig. 3. *Epeira dubitabilis*, sp. nov. *a*, palpus of male.
Fig. 4. *E. guttatum*, sp. nov. Vulva.
Fig. 5. *E. ostri-brunnea*, sp. nov. Vulva.
Fig. 6. *Tetragnatha typica*, sp. nov. Palpus.
Fig. 7. „ „ sp. nov. Falces.
Fig. 8. *Stephanopis angulatus*, sp. nov. Palpus.

ART. XXIX.—*Descriptions of New Species of New Zealand* Araneæ, *with Notes on their Habits.*

By P. GOYEN, F.L.S.

[*Read before the Otago Institute, 12th November, 1889.*]

Fam. CTENIDÆ.

Gen. CYCLOCTENUS, Koch.

Cycloctenus fugax, sp. nov.

Femina.—Length, 13mm.; length of cephalothorax, 5mm. Legs, 4, 1, 2, 3; 1, 2, and 3 not differing greatly in length.

Cephalothorax and abdomen of a brownish-yellow ground-colour, mottled with black or dark-brown, and moderately thickly covered with short appressed reddish hair, the whole superior surface of the body presenting a brilliant brindled appearance. The predominating colour at the sides and in front of the pars cephalica is dark-brown, and between the posterior row of eyes and the anterior extremity of the thoracic fovea brownish-yellow, with flecks of a darker hue. On the lateral slopes of the pars cephalica the dark flecks are somewhat wedge-shaped, and lie parallel with the lateral indentations. Sternum and maxillæ brown; falces and labium dark-brown. Legs and palpi of the same ground-colour as the body, flecked and annulated with brown. On the dorsal surface of the abdomen there is a fairly distinct pattern formed by a brown fleck in the median line near the base, and four others, two on each side—the first pair situated about half-way between the base and the posterior extremity, and connected with the basal fleck by two rather indistinct lines; the second pair about a millimetre behind the first, and also connected by faint lines. The lines connecting the first pair make a somewhat acute and those connecting the second pair an obtuse angle. Most of the ventral surface between the vulva and the spinners is of a reddish hue, due to the colour of the hair. Vulva reddish- and dark-brown. The dorsal pattern of the abdomen varies a good deal, according to the age of the spider.

Cephalothorax somewhat longer than the tibia of a leg of the fourth pair, much constricted at the caput, the sides of which are nearly vertical, here about half as wide as at the broadest part of the thorax, which is strongly rounded at the sides, somewhat dome-shaped, as high as or a trifle higher than the caput, and moderately steep; central and lateral indentations all very distinct; so is the junction between the

caput and the thorax. Ocular area very hairy and nearly black, that part of it occupied by the centrals of the middle and the front row of eyes almost in the same plane with the clypeus, which is low.

Eyes, with the exception of the somewhat elliptical laterals of the middle row, round; those of the posterior row the largest, and the centrals of the middle row larger than the eyes of the front row; all placed on tubercles; those of the front row about the same distance from each other as from the base of the clypeus and the centrals of the middle row; the laterals of the middle row very small, below the plane of the centrals, and posited nearly half-way between them and the eyes of the posterior row; the centrals of the middle row nearer to each other than to the eyes of the posterior row; the laterals of the middle row opalesque, and the rest of a dark colour. The curve of the middle row is slightly directed forwards.

Falces hairy, convex in front near the base, slightly diverging towards the extremities, anterior side of groove furnished with a long fringe of hair and armed with four teeth (the basal tooth very minute), the posterior side armed with two large distant teeth, which are nearer the claw than those of the anterior side; claw of moderate length and strength.

Maxillæ convex, narrowest at the base, very gradually increasing in breadth towards the extremities, slightly rounded on the outside and in front, where there is a dense fringe, somewhat inclined to the labium.

Labium convex, quadrate in outline, constricted at the base, slightly emarginate in front, and rather more than half as long as the maxillæ.

Sternum round-cordate, very slightly convex, and moderately hairy.

Abdomen oval, convex, wider than the cephalothorax. Spinners inconspicuous, somewhat laxly grouped; superior and inferior pair not differing greatly in length and strength; the central pair very small.

The *tarsi* of all the legs without spines; the four anterior tibiæ with 2, 2, 2, 2 spines below, and 2 at the sides; the metatarsi of the same legs with 2, 2, 2, 2 below, and 2, 2 at the sides; tarsal claws 3, superior with fine teeth, anterior one the largest; inferior claw with one tooth.

Palpi of moderate strength, humeral joint bent and thickened towards the extremity, more hairy below than above, spines 1, 1, 1, rather shorter than cubital + radial joint; the latter longer than the former; digital joint about equal in length to cubital + radial, well armed with spines and furnished with a 4-toothed claw, the anterior tooth large, and the posterior very minute.

Vulva somewhat semi-elliptical in outline, the fovea limited posteriorly by a transverse corneous costa and laterally by two strong bent converging tooth-like processes, one on each side, that spring from the posterior costa.

Hab. Dunedin and the Clutha Valley; *P. G.*

One of our most handsome spiders, very timid, and so nimble and prodigal of limb that to capture it intact is no easy matter. It is surprising with what swiftness it can run, even after losing half its legs. With one leg on each side it is a fair match for many spiders with the full complement of legs. It is found under stones of considerable size, and often with *Cambridgea fasciata*, with which it seems to live on terms of amity. It affects bush country, but is sometimes found in the open. Its cocoon, which contains about sixty roundish, yellow, jelly-like eggs, is of a plano-convex shape, and firmly attached by its plane surface to the under-side of stones. To render it as inconspicuous as possible its fabricator generally sprinkles its exposed surface with earth of the colour of the surface to which it is attached. The texture of this cocoon resembles that of parchment. In general appearance the male exactly resembles the female.

Fam. ENYOIDÆ.

Gen. HABRONESTES, Koch.

Habronestes marinus, sp. nov.

Femina.—Length, 8mm.; length of cephalothorax, 3½mm. Legs, 4, 1, 2, 3.

Cephalothorax of a chocolate-brown ground-colour, glossy and tinged with olive-green, the lower portion of the thoracic slope being yellow, and the lateral indentations of a darker hue than the ridges between them; falces, maxillæ, and labium reddish-brown, the two latter of a somewhat lighter hue than the former, and the labium darker at the base than elsewhere; sternum pale-yellow in the middle almost from end to end, and, between this central yellow area and the red-brown margin, dark-brown; legs yellow or reddish-yellow towards the base, from there passing gradually into brown towards the extremities, marked with brown stripes or annulations and slightly tinged with olive-green. Dorsal and lateral surface of the abdomen of a darker hue than the cephalothorax, with a median broken line of dull-yellow, having on each side of it two rows of dull-yellow markings, the outer row on each side somewhat irregular, the inner row on each side and the median broken line coalescing thus Λ about two-thirds of the length of the abdomen from the base, and thence so continuing to the anus; the ventral surface yellow on the basal side of the transverse groove, between this groove and the spinners very

dark brown at the sides, dusky-yellow in the middle, and here covered with a very dense pubescence. The dorsal surface is much less hairy, but more copiously furnished with bristles. The dark portions of the abdominal surface are very finely mottled with dull-yellow.

Cephalothorax about 1mm. longer than broad at the broadest part, and here less than 1mm. broader than at the fore-part of the caput; pars cephalica sloping forward, the back of the cephalothorax thus forming a continuous curve; normal indentations moderately distinct; sides slightly rounded; back and fore-part of caput very sparsely furnished with coarse hairs.

Eyes on small black eminences, the centrals of the middle row very minute, the rest not differing greatly in size, and round, or almost so; those of the front row nearer to the laterals of the middle row than these latter are to the eyes of the posterior row, but more distant from each other than those of the posterior row are from each other; the centrals of the middle row slightly nearer each other than to the front eyes, and nearer to these than to the laterals of their own row; the curve of the middle row directed forward. Height of clypeus less than the space between a central and a lateral of the middle row.

Falces almost vertical, inclined forwards rather than backwards, at the base projecting beyond the plane of the clypeus; glossy and finely rugulose, furnished with hairs at the sides and extremities, and with a dense fringe at the anterior side of the groove, the latter with 4 teeth on the posterior side, the one nearest the fang the largest, and the basal one very minute, and three on the anterior side, the middle one of which is large and the other small, the basal tooth being much more distant from it than the other.

Maxillæ convex, in front of the palpal junction oblong in outline, inclined to the labium, in front slightly rounded on the outside and obliquely truncated on the inside, and here furnished with a dense dark-coloured fringe.

Labium convex, widest above the basal constriction, narrowest in front and here truncated, more than half as long as the maxillæ.

Sternum slightly convex, oblong-cordate, truncated in front and strongly pointed posteriorly, somewhat impressed opposite the legs, very glossy and very sparsely furnished with coarsish black hairs.

Abdomen oblong-ovate, convex, at its widest part wider than the cephalothorax; inferior spinners by far the largest, in front of them a tuft of hair that, seen with the naked eye or with a glass of very low power, looks like a small mammilla.

The *tarsi* without spines (1 or 2 on one of the 4th legs in some examples); the tibiæ and metatarsi of the 3rd and 4th pairs so heavily armed with spines as to resemble veritable *chevaux-de-frise;* on the inferior surface of the corresponding joints of the 1st and 2nd pairs 6 to 8 spines, the distribution of which is somewhat irregular—on the tibiæ 2, 2, 2; 3, 1, 1, 2, or 3, 1, 1, 1, 2, and on the metatarsi 2, 2, 2, or 2, 1, 2, 2; tarsal claws 3, superior with several teeth, inferior bent vertically down and simple.

Palpi slender, joints all armed with 1 or more spines—humeral joint with 1, 1, 2, or 1, 1, 1 above, this joint slightly bent and increasing a little in thickness towards the fore extremity, and in length not differing much from the digital joint; the cubital joint by much the shortest, and thickened in front; digital joint furnished with a finely-toothed claw.

Of the *corpus vulvæ* the sides are brown, and the posterior, anterior, and central parts pale-yellow; the brown parts corneous, pitted with circular cavities, posteriorly near to and anteriorly distant from each other, having thus the shape of a horse-shoe with the heels directed forward, and the toe broken through by the yellowish neck of the somewhat spathulate vulvular concavity. Slightly outside the front of each heel there is an oblique elongated bald depression having the same hue as the branchial opercula, and in front of each of these depressions another smaller depression of the same hue.

Though much smaller, the male closely resembles the female in form. Length, 5mm.; relative length of cephalothorax and abdomen nearly the same as in the female. Cephalothorax and its appendages reddish-yellow; coloration and markings of abdomen similar to those of the female's. On the outside, at the fore extremity of the radial joint of the palpi, two short stout apophyses close together, the one flesh-coloured, the other brown; digital joint turbinate, having on the under-surface at the base a hollow in which are situated the palpal organs, in the centre of the hollow a loop-shaped yellow corneous process partly concealed by a membraneous scale, and springing from the base a dark-coloured filiform spine, which, after passing along the inside and round the front, terminates on the outside at no great distance from the base.

I have several females, but only one male.

Hab. Dunedin Harbour. *P. G.*

This interesting spider is found on the under-surface of stones between high- and low-water mark, being at full-tide immersed in from a few inches to a foot or more of water. When detached from the stones it rises to the surface like a cork, and at once simulates death. In this condition it will bear a good deal of pushing about without showing the

least sign of life; but a slight pinch with the forceps makes it either run smartly along the surface of the water or strenuously struggle to dive. It, however, never succeeds in getting more than its head and some of its legs under water. Like *Amaurobioides maritima*, Cambridge, and *Dolomedes aquaticus* and *Lycosa uliginosa*, Goyen, it is wholly unable to dive. To get under water it must, like them, have some support for its legs. It is able to run at a fair pace on the upper, but much faster on the under surface of stones. This is no doubt owing to the circumstance that its body, with the air entangled in its pubescence, is of lower specific gravity than sea-water. On the upper surface part of its energy is spent in holding its body down, but on the under-surface most of it may be employed in running. Owing to the fact that the stone must be turned a little to expose the spider to view, I have been unable to determine whether during immersion it seeks its prey or remains inactive. It is difficult to believe that any land animal would adopt this mode of existence merely for the sake of being under water during a considerable portion of its life. On the stones under which it lives there is abundance of animal life upon the juices of which it might feed; I incline, therefore, to the view that it lives partly, if not entirely, upon the juices of marine animals, and that its preference for this kind of food has induced it to take to sea-water. I have also found examples of this spider in the crevices of the banks laved by the water at full-tide, but, though I have searched diligently for it, have never met with it at any greater distance from the sea.

Its cocoon, which is of a plano-convex shape, and attached firmly by its plane surface to the under-side of stones, is also under water during a large portion of every day; and the young, as soon as they leave the cocoon, seem as much at home in that element as the mother spider. The material of the cocoon is of a thin leathery consistence, and apparently impervious both to air and water. It contains about twenty rather large pale-yellow, roundish eggs, which are placed in tiers, and built into a rude sort cf cone. They are loosely agglutinated together, and attached to the central part of the roof of the cocoon, which is invariably well inflated with air. The young remain in the cocoon for some time after they are hatched, and this imprisoned air is no doubt intended for their use. Owing to its whitish colour, the cocoon is a rather conspicuous object; but its fabricator is in colour so much like the bits of wood and other material adhering to the stones that it is difficult to distinguish it from them. It constructs neither snare nor protective tube that I could discover. The air by which its existence is supported during immersion is held entangled in the dense pubescence of the abdominal ventral surface.

I have another spider, a member of the family *Attoidæ*, found in the bay in the same locality, and having the same habit, except that it constructs for itself a protective tube; but, owing to the difficulty of assigning an example to its genus in a family containing so many ill-defined genera, I have been unable to determine in which to place it. This is the fourth marine spider discovered in New Zealand, which is, I believe, the only country in which such spiders have been found.

ART. XXX. — *On a New Genus of Fishes of the Family* Percidæ, *from New Zealand.*

By H. O. FORBES, F.R.G.S., F.Z.S., A.L.S., Director of the Canterbury Museum, Christchurch, New Zealand.

[*Read before the Philosophical Institute of Canterbury, 5th Sept., 1889.*]

PROFESSOR HUTTON described in 1875 a new species of *Percidæ*, which he founded on a stuffed specimen in the Otago Museum, Dunedin, under the name of *Therapon rubiginosus*. In his account of this fish in "Trans. N.Z. Inst.," viii., pp. 209–10, he says, "It differs from *Therapon* in the oblique cleft of the mouth, the forked caudal, and the greater development of the scales on the vertical fins; but I hesitate to draw up generic characters for it until I can get a fresh specimen." The opportunity of examining a second and particularly fine example of this rare fish has fallen to me, by the acquisition by this Museum of a specimen thrown on the beach, in July 1889, near the mouth of the river Avon, in the Province of Canterbury.

The specific description given by Professor Hutton in the volume I have cited leaves little to be desired in the matter of accuracy; a few points only, and those not easily to be made out in a dried skin, require addition or emendation. I am able also to confirm his opinion that a new genus would probably have to be established for its reception, of which I therefore append the diagnostic characters under the name of *Plagiogeneion*, and a completed description of the species.

PLAGIOGENEION,* gen. nov.

Body oblong, compressed, covered with ctenoid scales; eye equal in diameter to length of maxillary bone; mouth small, vertical; teeth small, villiform in both jaws; palate

* πλάγιος = perpendicular; γένειον = jawed.

toothless; patch on vomer. Operculum spiniferous, smooth; præoperculum finely serrated. Branchiostegals, 6. Dorsal received into a sheath, notched, with 12 spiny unequal, and 11 soft, rays; anal with 3 spiny and 9 soft rays. Scales quadrilateral, $\frac{6}{10}$in. Caudal deeply forked. Air-bladder simple. Cæca pylorica (9) few.

Plagiogeneion is thus separated by its vertical mouth from the following genera: *Therapon, Macquaria, Pristipoma, Hæmulon, Hapalogenys, Diagramma, Scolopsis, Dentex, Synagris, Pentapus;* and by its simple air-bladder from *Helotes, Conodon, Mæna,* and *Smaris;* by its dorsal-fin formula from *Hyperoglyphe, Gerres, Pristipomoides, Chætopterus, Aphareus, Cæsio, Erythrichthys, Pentaprion,* and *Polycentrus;* and by the form of its body from *Lobotes* (differentiated also by its pseudo-branchiæ) and *Datnioides* (also distinguished by the shape of its caudal fin).

Plagiogeneion rubiginosus, Hutton.

D., $\frac{11}{12}$; A., $\frac{3}{10}$; L. lat. 81, L. trans. 13/25.

General colour pink-red; above the dorsal line, and for 2 to 3½ scales below it, the colour is grey washed with pink-red, in consequence of a wide band on each scale of grey, margined with pink-red. The whole surface below the grey belt is deep salmon-pink. Each scale has a metallic purple spot, which falls into longitudinal lines of purple along the sides. The purple is replaced by deeper pink on the ventral surface between the ventral and anal fins. On the margins of the opercula the colour is nacreous purple; in front of the eye, and the whole of the maxillary bone and lower mandibles, are of a rich purplish-pink nacreous colour. The length is three times the height of the body, or four times the length of the head. The diameter of the eye goes three and a half times into the length of the head. Scales ctenoid, $\frac{6}{10}$ of an inch across, and quadrilateral in shape, with semicircular anterior margin.

Body compressed, the greatest height under the third dorsal spine. Mouth small, vertical, protrusive. Series of very minute teeth in each jaw; palate toothless. Vomer with a patch of teeth. Præoperculum slightly denticulated on its lower margin, smooth below; operculum smooth, armed with two small flat spines. Dorsal single, deeply notched; the fourth spine, which is the longest, goes nearly 2½ times into the length of the head. Spines of the dorsal and anal fin very strong. Anal and soft dorsal not covered with scales; the fins are received into a sheath, which is covered with fine scales; the spiny parts scaleless. Caudals and exteriors of pectorals and ventrals partly covered with scales. Caudal forked, each lobe about equal to the length of the head. The dorsal commences at the

base of the ventrals, and ends at a distance from the caudal equal to about two-thirds the length of the head. Pectorals pointed, the upper border the longest, but not so long as the head, and extending slightly further back than the points of the ventrals. Ventrals inserted behind the pectorals, and extending to a little more than half the distance to the vent, the lateral line extending on to the tail. Total length of the specimen, $15\frac{9}{10}$in.

Canterbury, mouth of River Avon.

ART. XXXI.—*List of the New Zealand Fishes.*

By Professor F. W. HUTTON.

[*Read before the Philosophical Institute of Canterbury, 3rd October, 1889.*]

DURING the eighteen years that have passed since the publication by the Geological Department of the Catalogue of the Fishes of New Zealand, several active workers have been in the field, who have added a number of additional species to our fauna; also many errors in nomenclature have been corrected, principally by Dr. A. Gunther, of the British Museum; and, in order to facilitate further progress, it seems to me to be desirable to collect together the information we now possess. With this object in view I have drawn up the following list, the arrangement followed being that of Dr. Gunther's "Study of Fishes." I have not thought it necessary to give complete references to all descriptions, but only those which show the evidence for the species being included in the list. In the references, Cat. means the "Catalogue of the Fishes of New Zealand, 1872;" and vol. means the volume of the "Transactions of the New Zealand Institute." An asterisk prefixed to a reference indicates that a figure will be found there. A note of interrogation prefixed to a species means that it is doubtful whether it really occurs in the New Zealand seas.

ELASMOBRANCHII.

CARCHARIDÆ.

1. CARCHARIAS BRACHYURUS, Gunther; Catalogue, p. 75.
2. GALEUS AUSTRALIS, Macleay, Cat. Australian Fishes, p. 290; *G. canis*, Cat., p. 81.
3. ZYGÆNA MALLEUS, Risso; Cat., p. 76; vol. 5, p. 271.
4. MUSTELUS ANTARCTICUS, Gunth.; *Cat., p. 76; fig. 123; vol. 15, p. 219.

Lamnidæ.

5. Lamna cornubica, Gml.; vol. 7, p. 237.
6. Carcharodon rondeletii, Mull. and Henle; Cat., p. 78.
7. Alopecias vulpes, Gml.; Cat., p. 78.

Notidanidæ.

8. Notidanus indicus, Cuv.; Cat., p. 79.

Scyllidæ.

9. Scyllium laticeps, Duméril; Cat., p. 79; vol. 8, p. 216.

Spinacidæ.

10. Centrina salviana, Risso. A specimen is in the Christchurch Museum.
11. Anthias vulgaris, Risso; Cat., p. 76.
12. Scymnus lichia, Cuv.; *vol. 15, p. 223.
13. Echinorhinus spinosus, Gml.; vol. 16, p. 280.

Rhinobatidæ.

14. (?) Rhinobatis banksii, Mull. and Henle; Cat., p. 82.
15. (?) Trygonorhina fasciata, Mull. and Henle; Cat., p. 82.

Torpedinidæ.

16. Torpedo fairchildi, Hutton; *Cat., p. 83, fig. 134.
17. „ fusca, Parker; *vol. 16, p. 281.

Rajidæ.

18. Raja nasuta, Solander; Cat., p. 84; vol. 8, p. 216.

Trygonidæ.

19. Trygon brevicaudatus, Hutton; vol. 8, p. 216.

Myliobatidæ.

20. Myliobatis tenuicaudatus, Hector; *vol. 9, p. 486.

Chimæridæ.

21. Callorhynchus antarcticus, Lacep.; Cat., p. 74.
22. „ dasycaudatus, Colenso; *vol. 11, p. 299.

TELEOSTEI.

Percidæ.

23. Anthias lepidoptera, Forster; *Scorpis hectori*, Hutton, *Cat., pp. 4 and 106, fig. 4.
24. Anthias longimanus, Gunth.; *Scorpis hectori*, Hutton, *vol. 5, p. 259; *S. fairchildi*, Hector, vol. 7, p. 241.
25. Plectropoma huntii, Hector; *vol. 7, p. 240.
26. Polyprion prognathus, Forst.; *Oligorus gigas*, *Cat., pp. 1 and 102, fig. 1; Ann. Nat. Hist., Sept., 1887, p. 236.

27. PENTACEROS RICHARDSONII, Smith. Specimens in the Canterbury Museum.
28. PLAGIOGENEION RUBIGINOSUS, Hutton (*Therapon*), vol. 8, p. 209; *Plagiogeneion*, Forbes, vol. 22, p. 273.
29. ERYTHRICHTHYS NITIDUS, Richardson; Cat., p. 3.
30. ARRIPIS SALAR, Rich.; *Cat., pp. 2 and 105, fig. 2.

SQUAMIPENNES.

31. ATYPICHTHYS STRIGATUS, Gunth.; *vol. 12, p. 308, *Atypus*.

MULLIDÆ.

32. UPENEICHTHYS VLAMINGII, C. and V.; Cat., p. 5, *Upenoides*; *vol. 9, p. 465.

SPARIDÆ.

33. GIRELLA SIMPLEX, Rich.; *vol. 9, p. 468: *G. percoides*, Hector, *vol. 7, p. 243: *Ctenolabrus knoxi*, Hutton, *vol. 5, pp. 265 and 308.
34. HAPLODACTYLUS MEANDRATUS, Rich.; *vol. 7, p. 241; vol. 8, p. 211: *H. donaldi*, Haast, *vol. 5, p. 272: *Chironemus georgianus*, Cat., p. 7.
35. PAGRUS UNICOLOR, Quoy and Gaim.; *Cat., pp. 6 and 106, fig. 7.

CIRRHITIDÆ.

36. CHIRONEMUS FERGUSONI, Hector; *vol. 9, p. 467: *Haplodactylus*, vol. 7, p. 243.
37. CHILODACTYLUS MACROPTERUS, Forst.; *Cat., pp. 8 and 107, fig. 10.
38. CHILODACTYLUS SPECTABILIS, Hutton; Cat., p. 8; *vol. 5, p. 259: *C. allporti*, Gunth., vol. 9, p. 469.
39. CHILODACTYLUS DOUGLASI, Hector; *vol. 7, p. 244.
40. (?) " CARPONEMUS, Gunth.; Cat., p. 7.
41. MENDOSOMA LINEATA, Gay; *vol. 5, p. 260. Not *Sciena lineata*, Forst.
42. LATRIS HECATEIA, Rich.; *Cat., pp. 8 and 107, fig. 12; *S. lineata*, Forst.
43. LATRIS CILIARIS, Forst.; *Cat., pp. 9 and 108, fig. 13.
44. " ÆROSA, Hutton; vol. 9, p. 353.

SCORPÆNIDÆ.

45. SEBASTES PERCOIDES, Solander; Cat., pp. 9 and 108; *vol. 5, p. 261.
46. SCORPÆNA CRUENTA, Solander; Cat., p. 9; *vol. 5, p. 261.
47. SCORPÆNA BARATHRI, Hector; *vol. 7, p. 245.
48. " BYSSOENSIS, Rich.; vol. 16, p. 323.
49. AGRIOPUS LEUCOPŒCILUS, Rich.; Cat., p. 11; vol. 8, p. 211.
50. (?) PROSOPODASYS COTTOIDES, L.; Cat., p. 11.

Berycidæ.

51. Trachyichthys elongatus, Gunth.; Cat., p. 12.
52. " intermedius, Hector; *vol. 7, p. 245.
53. " trailli, Hutton; vol. 8, p. 212; *vol. 17, p. 162.
54. Beryx affinis, Gunth.; *vol. 9, p. 466; *Ann. Nat. Hist., ser. 5, vol. 20, p. 238.

Xiphiidæ.

55. Xiphias gladius, L.; vol, 7, p. 246; vol. 8, p. 219.
56. Histiophorus herschelii, Gray; Cat., p. 14; *vol. 2, p. 13; vol. 8, p. 216.

Trichiuridæ.

57. Lepidopus caudatus, Euphasen; *Cat., pp. 13 and 109, fig. 19; vol. 8, p. 218.
58. Lepidopus elongatus, Clarke; *vol. 11, p. 294. Perhaps identical with *L. tenuis*, from Japan.
59. Thyrsites atun, Euphasen; *Cat., pp. 13 and 109, fig. 20.
60. Thyrsites prometheus, C. and V.; vol. 16, p. 322.

Acronuridæ.

61. (?) Acanthurus triostegus, L.; Cat., p. 15.

Carangidæ.

62. Caranx trachurus, L.; *Cat., pp. 16 and 110, fig. 23, *Trachurus*.
63. Caranx georgianus, C. and V.; *Cat., pp. 16 and 110, fig. 24.
64. Caranx koheru, Hector; *vol. 7, p. 247.
65. Seriola lalandii, C. and V.; *Cat., pp. 17 and 111, fig. 25.
66. Seriolella brama, Gunth.; *Cat., pp. 21 and 112, fig. 31, *Neptomenus*.
67. Seriolella bilineata, Hutton; *vol. 5, p. 261.
68. " porosa, Guichen; vol. 8, p. 211.
69. Neptotichthys violaceus, Hutton; *Ditrema violacea*, Hutton, *vol. 5, p. 261. As *Ditrema* has been placed near the *Labridæ*, I am compelled to make a new genus for this fish. It is distinguished from *Platystethus* by its dorsal fin, its præoperculum, and its dentition.
70. Platystethus huttoni, Gunth.; Ann. Nat. Hist., ser. 4, vol. 17, p. 395; vol. 9, p. 470; * "Challenger," Pelagic Fishes, p. 13, pl. ii.
71. Naucrates ductor, L.; Cat., p. 18.

CYTTIDÆ.

72. ZEUS FABER, L.; *Cat., pp. 18 and 111, fig. 27.
73. " NOVÆ-ZEALANDIÆ, Arthur; *vol. 17, p. 163.
74. CYTTUS AUSTRALIS, Rich.; *Cat., pp. 19 and 112, fig. 28.
75. " TRAVERSI, Hutton; Cat., p. 19; *vol. 5, p. 261.
76. " ABBREVIATUS, Hector; *vol. 7, p. 247, *Platystethus*.

CORYPHÆNIDÆ.

77. BRAMA RAII, Bleeker; *vol. 9, p. 405: *Toxotes squamosus*, Hutton, vol. 8, p. 210.
78. LAMPRIS LUNA, Risso; vol. 16, p. 322.
79. DISCUS AUREUS, Campbell; *vol. 11, p. 297.

NOMEIDÆ.

80. GASTROCHISMA MELAMPUS, Rich.; Cat., p. 20; *vol. 6, p. 104.

SCOMBRIDÆ.

81. SCOMBER AUSTRALASICUS, C. and V.; *Cat., pp. 21 and 112, fig. 32.
82. LEPIDOTHYNNUS HUTTONI, Gunth.; *"Challenger," Pelagic Fishes, p. 16, pl. vi.
83. PELAMYS CHILENSIS, C. and V. (?); Cat., p. 22.
84. ECHENEIS BRACHYPTERA, Lowe; vol. 8, p. 217.

TRACHINIDÆ.

85. ANEMA MONOPTERYGIUM, Bleeker; Cat., p. 23, *Kathetostoma;* vol. 6, p. 104; vol. 9, p. 469; *Synnema,* Haast, vol. 5, p. 274; *K. giganteum,* Haast, *vol. 5, p. 274.
86. KATHETOSTOMA LÆVE, Bleeker; Cat., p. 23.
87. " FLUVIATILIS, Hutton; Cat., p. 24.
88. LEPTOSCOPUS MACROPYGIUS, Rich.; *vol. 6, p. 116; *L. huttonii,* Haast, *vol. 5, p. 275.
89. CRAPATALUS NOVÆ-ZEALANDIÆ, Gunth., Ann. Nat. Hist., ser. 3, vol. 7, p. 87: *L. angusticeps,* Hutton, *vol. 6, p. 106: *L. robsoni,* Hector, vol. 7, p. 248: *L. canis,* Arthur, vol. 17, p. 165.
90. PERCIS COLIAS, Forst.; *Cat., pp. 25 and 113, fig. 38.
91. " GILLIESII, Hutton; Ann. Nat. Hist., ser. 5, vol. 3, p. 53.
92. BOVICHTHYS VARIEGATUS, Rich.; Cat., p. 24; *vol. 5, p. 262.
93. CHEIMARRICHTHYS FORSTERI, Haast; *vol. 6, p. 103.
94. NOTOTHENIA MAORIENSIS, Haast; *vol. 5, p. 276. *N. coriiceps* of Catalogue.
95. NOTOTHENIA ANGUSTATA, Hutton; vol. 8, p. 213.

96. Notothenia cornucola, Rich.; Cat., p. 26; vol. 5, p. 262.
97. Notothenia arguta, Hutton; vol. 11, p. 339.
98. " microlepidota, Hutton; vol. 8, p. 213.
99. " parva, Hutton; vol. 11, p. 339.

Psychrolutidæ.

100. Neophrynichthys latus, Hutton; *Psychrolutes latus*, Hutton, vol. 8, p. 214: *Neophrynichthys*, Gunth., Ann. Nat. Hist., ser. 4, vol. 17, p. 395; vol. 9, p. 470; *vol. 17, p. 166.

Pediculati.

101. Saccarius lineatus, Gunth.; Cat., p. 30.
102. Ægœsnichthys appellii, Clarke; *vol. 10, p. 245.

Cottidæ.

103. Lepidotrigla brachyoptera, Hutton; Cat., p. 27; *vol. 5, p. 263.
104. Trigla kumu, Less. and Garn.; *Cat., pp. 28 and 113, fig. 42.

Gobiidæ.

105. Gobius lentiginosus, Rich.; Cat., p. 29.
106. Eleotris gobioides, C. and V.; Cat., p. 29; *vol. 5, p. 263.
107. Eleotris radiata, Quoy and Gaim.; *vol. 5, p. 263.

Trichonotidæ.

108. Hemerocœtes acanthorhynchus, Forst.; Cat., p. 37.

Blenniidæ.

109. Clinus rubrus, Hutton; *vol. 5, p. 264: *Sticharium rubrum*, Cat., p. 33.
110. Clinus flavescens, Hutton; *vol. 5, p. 264: *Sticharium flavescens*, Cat., p. 33.
111. Cristiceps australis, C. and V.; vol. 5, p. 264.
112. Tripterygium forsteri, C. and V.; *Blennius tripennis*, Forst.
113. Tripterygium decemdigitatus, Clarke; *vol. 11, p. 292. Perhaps the same as the last.
114. Tripterygium medium, Gunth.; Cat., p. 32.
115. " dorsalis, Clarke; *vol. 11, p. 291.
116. " varium, Forst.; *T. nigripenne*, C. and V., vol. 5, p. 263.
117. Tripterygium robustum, Clarke; *vol. 11, p. 292: *T. jenningsi*, Hutton, vol. 11, p. 339.

118. AUCHENOPTERUS FENESTRATUS, Forst. (*Blennius*); *T. compressum*, Hutton; *vol. 5, p. 263; *vol. 17, p. 168.
119. ACANTHOCLINUS LITTOREUS, Forst.; Cat., p. 34.
120. " TAUMAKA, Clarke; *vol. 11, p. 293.

SPHYRÆNIDÆ.

121. SPHYRÆNA OBTUSATA, C. and V.; *vol. 12, p. 310.

ATHERINIDÆ.

122. ATHERINA PINGUIS, Lacep.; *vol. 12, p. 309.

MUGILIDÆ.

123. MUGIL CEPHALOTUS, C. and V.; vol. 4, p. 189; *vol. 5, p. 264: *M. perusii*, *Cat., pp. 36 and 113, fig. 57.
124. AGONOSTOMA FORSTERI, Bleeker; *Cat., pp. 37 and 114, fig. 58.

CENTRISCIDÆ.

125. CENTRISCUS HUMEROSUS, Rich.; Cat., p. 38.

GOBIESOCIDÆ.

126. DIPLOCREPIS PUNICEUS, Rich.; Cat., p. 40; vol. 8, p. 214.
127. TRACHELOCHISMUS PINNULATUS, Forst.; Cat., p. 40; vol. 8, p. 214.
128. TRACHELOCHISMUS GUTTULATUS, Hutton; Cat., p. 41.
129. CREPIDOGASTER HECTORIS, Gunth.; Ann. Nat. Hist., ser. 4, vol. 17, p. 396; vol. 9, p. 471.

TRACHYPTERIDÆ.

130. REGALECUS PACIFICUS, Haast; *vol. 10, p. 247; vol. 11, p. 269.
131. REGALECUS ARGENTEUS, Parker; *vol. 16, p. 284; vol. 20, p. 20.
132. TRACHYPTERUS ALTIVELIS, Kner.; vol. 5, p. 264; vol. 8, p. 214.
133. TRACHYPTERUS ARAWATA, Clarke; *vol. 13, p. 195.

NOTACANTHI.

134. NOTACANTHUS SEXSPINIS, Rich.; Cat., p. 39.

POMACENTRIDÆ.

135. (?) DASCYLLUS ARUANUS, L.; Cat., p. 42.

LABRIDÆ.

136. COSSYPHUS UNIMACULATUS, Gunth.; vol. 16, p. 323.
137. LABRICHTHYS FUCICOLOR, Rich.; vol. 5, p. 265; *Cat., fig. 68 (*bothryocosmus*).

138. LABRICHTHYS BOTHRYOCOSMUS, Rich.; Cat., p. 43; *vol. 5, p. 265.
139. LABRICHTHYS COCCINEA, Forst.; *L. psittacula*, Cat., p. 43; *vol. 5, p. 265.
140. LABRICHTHYS CELIDOTA, Forst.; Cat., p. 42.
141. „ CINCTA, Hutton; vol. 9, p. 354.
142. „ LATICLAVIUS, Rich.; vol. 16, p. 323.
143. CYMOLUTES SANDEYERI, Hector; vol. 16, p. 323.
144. ODAX VITTATUS, Solander; Cat., p. 43; vol. 5, p. 266; vol. 8, p. 214; vol. 12, p. 310; *vol. 17, p. 169.
145. CORIDODAX PULLUS, Forst.; *Cat., pp. 44 and 114, fig. 71; vol. 3, p. 130; vol. 5, p. 266.

LYCODIDÆ.

146. HYPOLYCODES HAASTII, Hector; vol. 13, p. 194.

GADIDÆ.

147. BATHYGADUS COTTOIDES, Gunth.; Ann. Nat. Hist., ser. 5, vol. 2, p. 23; *"Challenger," Deep-sea Fishes.
148. MERLUCCIUS GAYI, Guichen; *Gadus australis*, Hutton, *Cat., pp. 45 and 115, fig 72.
149. HALARGYREUS JOHNSONII, Gunth.; Cat., p. 45.
150. PSEUDOPHYCIS BACHUS, Forst.; *Cat., pp. 46 and 115, fig. 75.
151. PSEUDOPHYCIS BREVIUSCULUS, Rich.; *Cat., p. 47, fig. 76.
152. LOTELLA RHACINUS, Forst.; Cat., p. 46; vol. 5, p. 266; *vol. 6, plate 18.
153. MOTELLA NOVÆ-ZEALANDIÆ, Hector; *vol. 6, p. 107.
154. AUCHENOCEROS PUNCTATUS, Hutton, Gunth. in *"Challenger," Pelagic Fishes, p. 26, pl. iii.; *Calloptilum punctatum*, Hutton, *vol. 5, p. 267 (fig. wrong); *Bregmaceros punctatus*, Gunth., Ann. Nat. Hist., ser. 4; vol. 17, p. 398.

OPHIDIIDÆ.

155. DINEMATICHTHYS CONSOBRINUS, Hutton; vol. 8, p. 217; *vol. 9, p. 466.
156. GENYPTERUS BLACODES, Forst.; *Cat., pp. 48 and 116, fig. 77.

GADOPSIDÆ.

157. GADOPSIS MARMORATUS, Rich.; Ann. Mag. Nat. Hist., ser. 4, vol. 1, p. 342.

MACRURIDÆ.

158. MACRURUS AUSTRALIS, Rich.; *Cat., p. 49, fig. 78; vol. 5, p. 267.

159. MACRURUS ARMATUS, Hector; *vol. 7, p. 249.
160. " LONGIROSTRIS, Gunth.; Ann. Nat. Hist., ser. 5, vol. 2, p. 23; *"Challenger," Deep-sea Fishes.
161. MACRURORUS NOVÆ-ZEALANDIÆ, Hector; *Cat., p. 49, fig. 79; *vol. 3, p. 136, *Coryphænoides.*
162. CORYPHÆNOIDES DENTICULATUS, Rich.; *Cat., p. 49, fig. 80.
163. CORYPHÆNOIDES MURRAYI, Gunth.; Ann. Nat. Hist., ser. 5, vol. 2, p. 26; *"Challenger," Deep-sea Fishes.
164. CORYPHÆNOIDES SERRULATUS, Gunth.; *l.c.*, p. 26; *"Challenger," Deep-sea Fishes.

PLEURONECTIDÆ.

165. BRACHYPLEURA NOVÆ-ZEALANDIÆ, Gunth.; Cat., p. 50.
166. PSEUDORHOMBUS SCAPHUS, Forst.; *Cat., p. 51, fig. 82.
167. " BOOPS, Hector; *vol. 7, p. 249.
168. AMMOTRETIS ROSTRATUS, Gunth.; vol. 8, p. 215.
169. " GUNTHERI, Hutton; *vol. 5, p. 267.
170. RHOMBOSOLEA MONOPUS, Gunth., *Cat., pp. 51 and 117, fig. 83: *Bowenia novæ-zealandiæ*, Haast, *vol. 5, p. 277, monstrosity.
171. RHOMBOSOLEA FLESOIDES, Gunth.; vol. 8, p. 215: *R. leporina*, *vol. 5, p. 268.
172. RHOMBOSOLEA TAPIRINA, Gunth.; *vol. 6, p. 106; vol. 8, p. 215; vol. 9, p. 471.
173. RHOMBOSOLEA RETIARIA, Hutton; vol. 6, p. 107: *R. tapirina*, *vol. 5, p. 258.
174. PELTORHAMPHUS NOVÆ-ZEALANDIÆ, Gunth.; *Cat., p. 52, fig. 84.

SCOPELIDÆ.

175. SCOPELUS PARVIMANUS, Gunth. (?); *vol. 5, p. 269.
176. " HECTORIS, Gunth.; Ann. Nat. Hist., ser. 4, vol. 17, p. 399; vol. 9, p. 471.
177. SCOPELUS BOOPS, Rich.; vol. 5, p. 269.
178. " CORUSCANS, Rich. (*Myctophum*); vol. 5, p. 270.
179. BATHYSAURUS FEROX, Gunth.; Ann. Nat. Hist., ser. 5, vol. 2, p. 182; *"Challenger," Deep-sea Fishes.
180. CHLOROPHTHALMUS GRACILIS, Gunth.; *l.c.*, p. 182; *"Challenger," Deep-sea Fishes.

SCOMBRESOCIDÆ.

181. SCOMBRESOX FORSTERI, C. and V.; Cat., p. 53.
182. HEMIRHAMPHUS INTERMEDIUS, C. and V.; *Cat., pp. 53 and 118, fig. 86.
183. EXOCŒTUS MICROPTERUS, C. and V. (?); Cat., p. 54.
184. " SPECULIGER, C. and V.; Cat., p. 55.

Galaxidæ.

185. Galaxias alepidotus, Forst.; Cat., p. 58.
186. „ fasciatus, Gray; *Cat., pp. 59 and 128, fig. 94.
187. „ brevipinnis, Gunth.; Cat., p. 59: *G. grandis*, Haast, *vol. 5, p. 278.
188. Galaxias olidus, Gunth.; vol. 5, p. 270.
189. „ attenuatus, Jenyns; *Cat., p. 60, fig. 96; *vol. 2, p. 84, fig. 2.
190. Neochanna apoda, Gunth.; *Cat., pp. 61 and 130, fig. 97.

Sternoptychidæ.

191. Photichthys argenteus, Hutton; Cat., p. 56; *vol. 5, p. 269.
192. Argyropelecus intermedius, Clarke; *vol. 10, p. 244.
193. Maurolicus amethystino-punctatus, Cocco; vol. 9, p. 472: *M. australis*, Hector, *vol. 7, p. 250.

Salmonidæ.

194. Retropinna richardsoni, Gill; *Cat., pp. 58 and 126, fig. 92; *vol. 2, p. 81, fig. 1: *R. osmeroides*, Hector, *vol. 3, p. 134.
195. Argentina decagon, Clarke; *vol. 11, p. 296: *A. elongata*, Hutton, Ann. Nat. Hist., ser. 5, vol. 3, p. 53.

Haplochitonidæ.

196. Prototroctes oxyrhynchus, Gunth.; *Cat., pp. 57 and 123, fig. 21; vol. 10, p. 250; vol. 17, p. 171: *R. upokororo*, Hector, *vol. 3, p. 134.

Gonorhynchidæ.

197. Gonorhynchus greyi, Rich.; *Cat., pp. 62 and 119, fig. 98.

Clupeidæ.

198. Engraulis encrasicholus, var. antipodum, Gunth.; *Cat., p. 62, fig. 99; vol. 5, p. 270.
199. Clupea sagax, Jenyns; *Cat., p. 63, fig. 100; *vol. 15, p. 208.
200. Clupea sprattus, var. antipodum, Hector; Cat., p. 133; *vol. 15, p. 203.
201. Chanos salmoneus, Forst.; *Cat., p. 64, fig. 101.

Murænidæ.

202. Anguilla aucklandica, Rich.; *Cat., pp. 64 and 131, fig. 102.
203. Anguilla latirostris, Risso; Cat., p. 65; vol. 5, p. 271.
204. „ australis, Rich.; *Cat., p. 65, fig. 104.

205. CONGER VULGARIS, Cuv.; *Cat., p. 66, fig. 105.
206. CONGROMURÆNA HABENTATA, Rich.; *Cat., p. 66, fig. 106.
207. OPHICHTHYS SERPENS, L.; Cat., p. 66: *S. novæ-zealandiæ*, Hector, *vol. 2, p. 34.
208. MURÆNA KRULLI, Hector; *vol. 9, p. 468.

SYGNATHIDÆ.

209. SYGNATHUS PELAGICUS, L.; Cat., p. 67.
210. " BLAINVILLIANUS, Edy. and S.; vol. 9, p. 472.
211. DORYICHTHYS ELEVATUS, Hutton; Cat., p. 68.
212. ICHTHYOCAMPUS FILUM, Gunth.; Cat., p. 68.
213. STIGMATOPHORA LONGIROSTRIS, Hutton; Cat. p. 69; vol. 8, p. 216.
214. SOLENOGNATHUS SPINOSISSIMUS, Gunth.; Cat., p. 69.
215. HIPPOCAMPUS ABDOMINALIS, Lesson; Cat. p. 70.

SCLERODERMI.

216. MONACANTHUS SCABER, Forst.; *M. convexirostris*, Gunth., *Cat., p. 71, fig. 114.
217. OSTRACION FORNASINI, Bianc. (?); Cat., p. 71.

GYMNODONTES.

218. TETRODON RICHEI, Fremiv.; Cat., p. 72.
219. DICOTYLICHTHYS JACULIFERUS, Cuv.; *Chilomycterus* of Cat., p. 73.
220. ORTHAGORISCUS MOLA, L.; vol. 5, p. 271; vol. 18, p. 135; *O. truncatus* of Cat., p. 73.

CYCLOSTOMATA.

PETROMYZONTIDÆ.

221. GEOTRIA CHILENSIS, Gray; Cat., p. 87; *vol. 5, p. 271; vol. 8, p. 216.
222. GEOTRIA AUSTRALIS, Gray; *vol. 5, p. 272.

MYXINIDÆ.

223. BDELLOSTOMA CIRRHATUM, Forst.; Cat., p. 87.

LEPTOCARDIA.

CIRROSTOMI.

224. BRANCHIOSTOMA LANCEOLATUM. Pall.; Cat., p. 88.

INCERTÆ SEDIS.

225. LEPTOCEPHALUS LONGIROSTRIS, Kaup; vol. 7, p. 238.
226. " ALTUS, Rich.; vol. 8, p. 215.

ART. XXXII.—*Observations on the Mokohinou Islands and the Birds which visit them.*

By F. SANDAGER.

[*Read before the Otago Institute, 11th June, 1889.*]

THE Mokohinou group consists of a number of islands, situated about twelve miles to the north-west of the Great Barrier Island, all of volcanic formation, more or less precipitous, and divided from each other by narrow—rarely deep—channels; the two largest islands being deeply indented and one of them almost bisected by the constant action of the sea. The vegetation of the several islands consists principally of flax (*Phormium tenax*), grasses, fern (*Pteris aquilina*, var. *esculenta*, and *Adiantum æthiopicum*), cyperaceous plants, *Mesembryanthemum*, *Veronica*, *Coprosma*, *Myoporum*, *Metrosideros*, *Pittosporum*, native broom (*Carmichælia* sp.), and *Olearia* sp., all the last-mentioned being more or less scattered, and, owing to the absence of shelter, stunted. The tuatara lizard is found in abundance on two of the islands, and I have noted the occurrence of six other species, but in no case more than two kinds on any one island. When it is considered that species of insects and plants found on one are often entirely absent from others close adjacent, each island might almost be said to possess a distinct fauna and flora of its own. Out of 130 species of *Coleoptera* collected fully one-third proved new, and have for the greater part been described by Captain Thomas Broun, M.E.S. Amongst other interesting insects found is a trap-door spider that forms a very pretty nest on the bark of a species of *Coprosma*. The young are hatched in the nest, where they remain for a considerable time together with the female. Nest and lid are invariably constructed in such a manner that only the closest scrutiny can distinguish them from the surrounding bark, for if the bark is covered with moss or lichens the nest is made to correspond.

Numerous birds visit the islands annually for breeding or other purposes; and, before proceeding to give a list of these, I will mention that for over a year after the light was first exhibited many sea-birds used to strike the lantern almost every night. This, year after year, has happened less frequently, for whereas formerly dozens of birds might be observed circling round and round the light, in a direction contrary to that in which the apparatus revolved, till at last they became dazzled, it rarely occurs now (after a lapse of close upon six years), if I except two species,

and these only for a short time of the year. This is not because the birds are less abundant than formerly—quite the contrary—but they have to some extent become accustomed to the light, and, though attracted by it, generally succeed in getting above or below the rays instead of circling round on a level with them; the same birds no doubt returning year after year till prevented by death or accident. I cannot otherwise account for their ability to avoid entanglement in the rays, more especially in thick weather. The two species which do strike in any numbers are Cook's petrel and *Thalassidroma fregata*, the former on its way to and from its breeding-place on the Little Barrier, and the latter on emerging from or returning to its burrow in the early part of the night. Cook's petrel is at all times attracted by a light—so much so that on the breeding-ground the birds will come close up to an open fire. In January, 1886, I secured a large *Puffinus* that flew against the lantern, which on examination proved abundantly distinct from any species described in the "Birds of New Zealand." I took down a description of the living bird, and, placing it in strong spirits, forwarded it after a time to Mr. T. F. Cheeseman, F.L.S., for preservation and identification, it being impossible for me to get away from the island; and Mr. Cheeseman subsequently informed me that he had been unable to identify it with any species of which a description was in his possession. I have described the bird below under the name of *Puffinus zealandicus*, and as soon as the specimen is returned to me it will be set up and deposited in one of our museums; but so far, I regret to say, nothing has been done to it.

Circus gouldi.

More or less abundant all the year. Destroys considerable numbers of one of the stormy petrels (*Thalassidroma fregata*) during the breeding-season, sometimes entering the short burrow, or waiting at the hole till the unsuspicious tenant comes to the mouth of it for air: this it has to do frequently, the nest being only a few inches below the surface, which is baked by the midsummer sun. At sunrise during the month of June I have frequently counted as many as thirty at a time coming from the south-east and flying towards the west or west-south-west.

Athene novæ-zealandiæ.

Does not breed here, but visits occasionally.

Halcyon vagans.

Arrives in February and departs in August or September. None breed here.

Prosthemadera novæ-zealandiæ.

Visits annually when the *Phormium* is in bloom, and again when the young are able to fly.

Anthornis melanura.

Visits occasionally during the winter. Last season (1888) I saw four.

Zosterops lateralis.

Winters every year in great numbers, which take their departure in August. During calm winter nights many fly against the lantern.

Anthus novæ-zealandiæ.

Common. Breeds on all the islands.

Rhipidura flabellifera.

Visits frequently from Fanal Island, where it breeds.

Platycercus novæ-zealandiæ.

Breeds on the Mokohinou and Fanal Islands. Lays in December. Egg white.

Nestor meridionalis.

Visits occasionally.

Eudynamis taitensis.

Arrives in October. Two wintered here in 1886. I have caught several on the lantern at night.

Chrysococcyx lucidus.

Arrives in October, and stops for a few days. Some fly against the lantern in thick weather.

Charadrius fulvus.

Visits every year in September, but only a few.

Anarhynchus frontalis.

Visits in October, but seldom more than two pairs, and they do not stay long.

Ardea sacra.

One or two visit every year, remaining for several months at a time. There is one here now (August) which I have seen nearly every day since February.

Limosa baueri.

More or less visit every year in October, remaining only for a few days.

Larus dominicanus.

Three or four pairs breed on some of the smaller islets every year. Lays at the end of October, and the young leave the nest in February.

Larus scopulinus.

Numbers breed here on a rock, but, for some reason or other, only every second year. There is no other breeding-place of theirs in the vicinity. When the *Cicadæ* make their appearance in the early part of summer they are eagerly followed in their short flights by this little gull, which may be seen busily feeding on them during the whole day for a week or two at a stretch, driving them out of the ngaio bushes and following them inland, or out over the water.

Sterna frontalis.

Breeds on the same rock as the preceding, every second year. Lays in October. The young are ready to fly near the middle of January.

Diomedea (sp. ?).

One or two visit the neighbourhood annually, but I have been unable to identify them. The last one I saw was in December, 1888.

Haladroma u inatrix.

Breeds on three of the smaller, comparatively low, islands, where it forms its burrow in the peat-like substance, consisting of light soil and decayed *Mesembryanthemum*, with which they are covered. Burrowing commences in April. In July a nest, consisting of dry flax, sticks, and grass, is formed at the end of the burrow, and a few of the earlier birds begin to lay during the last half of the month, but most of the laying takes place during August. The birds, previous to laying, are rarely found in the burrows during the day, all the work of burrowing, &c., being carried on at night. One egg only is laid in each nest. Colour of egg, white; length, 1·5in.; width, 1·25in.

Puffinus gavius.

This species never strikes the lantern. The young depart, some in the end of December, and the rest in January. Begins to burrow at the same time as the preceding, and does not work at or remain in the burrow during the day, previous to laying. No nesting-material save a few feathers is used, and all the burrows I examined were short, so that the egg could be easily reached without digging. A single egg is deposited in each nest, Colour of egg, white; average size of six eggs now before me—length, 2·31in.; width, 1·61in. Lay-

ing takes place at the beginning of September. Breeds on one island only, and not in great numbers. None have struck the lantern.

Puffinus assimilis.

Not very numerous, though it breeds on all the Mokohinou Islands. The burrow is generally under a rock, in the interstices between rocks, or less frequently on the level ground below a root or tussock. The nest is at all times difficult to get at—more so than that of any other species which breeds here. Burrowing commences in April and May, and is carried on at night only, so that the birds are rarely found in the burrows during the day, previous to laying. Nesting-material is deposited in the burrow during June and July, and at the end of the latter month laying commences, and extends to the middle of August. A single egg only is deposited in each nest. Colour of egg, white; length, 2·3in.; width, 1·4in. The young in down are greyish-black, excepting a narrow line of white on the throat and breast, which on reaching the abdomen divides into a right and left branch, uniting again behind the vent, thus leaving the abdomen grey. When the young birds depart they can scarce be distinguished from the old. They begin to leave in the end of December, and by the middle of January all have departed. This species very rarely comes against the lantern, and the burrow is seldom higher than 60ft. above the water.

Puffinus tristis.

Between the 3rd December and the 15th January, 1886–87, I found the nests of a species of *Puffinus* which differed somewhat from *P. tristis* as regards colour and measurements, and also in this: that the colour of the egg of the Mokohinou bird is white. I sent a skin to Mr. T. F. Cheeseman, F.L.S., who informs me that he has compared it with others undoubtedly *P. tristis*, and, allowing for individual peculiarities, finds them identical.

It is a rare bird here, and confines itself to three small patches of ground on different islands, only a few nests being found on each, and these not far apart.

The burrow is from 4ft. to 9ft. in length, and formed in such a way that the nest is between 2ft. and 3ft. under the surface, so that to get at the egg a pick or spade must be employed. This has invariably been the case in all I have examined, no matter whether the burrows were situated on rising or comparatively level ground. Long flax, growing in a deep light soil, is characteristic of the several breeding-places. In two burrows, which I dug out in December, a bird was found in each, sitting on an egg just laid; whilst in six others

I found a pair of birds in each, but no egg, the birds being still engaged sinking their burrow, or bringing in rubbish, of which a large quantity is used, for a nest.

This species bites viciously if the hand is inserted in the burrow after it is partly excavated, and to handle it with any degree of comfort, unless it is at once killed, the long sharp beak must be tied. The stomachs of those I skinned contained a dark-green substance, and several eyeballs (like those from a fish) ½in. in diameter, also beaks—possibly the remains of cephalopods. Laying-time from beginning of December to middle of January. Colour of egg white, much tapered. Largest egg found: length, 3·31in.; width, 1·91in. Smallest: length, 3in.; width, 1·75in. The young begin to leave in the middle of April, and by the end of May all are gone. It is worthy of note that the breeding-time of this bird differs from that of any other species found here. Both birds, for a month previous to laying, remain in the burrow during the day. None have ever struck the lantern.

Puffinus zealandicus, n. sp.

As previously mentioned, this species was secured by me in January, 1886, when it flew against the lantern, and up to June, 1888, no description of it has been found. The following description was taken from the living bird:—

Top of head (to a little below the eye) greyish-black. A small white spot beneath the lower margin of eye. Wings above, brownish-black; secondaries slightly edged with white. Neck, back, rump, and upper tail-coverts slate-grey. Tail-feathers brownish-black above and below. Chin, throat, lower part of wings, and the whole under-surface white, excepting the feathers on tibia, which are light-grey. Lower part of both mandibles bluish, remainder black. Outer margin of tarsus, and two outer toes, black; remainder pale, with a bluish tinge. Interdigital membrane pale, shaded with black.

Measurements: L., 18in.; W., 12in.; B., 2·15in.; tarsus, 2·11in.

I have sent to Auckland for the specimen, for, so far, I regret to say, nothing has been done to preserve it, and it has been kept in spirits since I first sent it up.

Procellaria parkinsoni.

Does not breed on any of the Mokohinou Islands, and only one example, which struck the lantern some years ago, has come under my notice.

Procellaria cookii.

Does not breed here, but numbers annually strike the lantern during calm, thick nights in October and November,

when they pass to and from their breeding-place on the north-east end of the Little Barrier Island. It is well known to the Maoris living there by the name of "titi," and is, no doubt, so called in reference to its cry. I measured many examples one year, and found that the measurements of different individuals varied considerably, and the colour to a slight degree, and am therefore of the opinion that *P. mollis* and *P. cookii* are identical, the distinction between these, so far as can be judged by descriptions, being principally based on measurements.

Procellaria gouldi.

This is the "oii" of the Barrier Maoris. Great numbers of this bird visit here annually for the purpose of breeding, and the young, when about ready to depart, are secured by the natives, who call with that intention, and boiled down in their own fat for future use. This, I am informed, has been the custom since time immemorial, and the ancestors of the people who now call occupied, at no very remote time, the Mokohinou Islands permanently, many of them being buried in part of the boulder-beach which is still considered *tapu*. This petrel begins to burrow in March, and continues to do so up to the middle of June, when more or less nesting-material is carried in, both birds being invariably found in the burrow during the day from May up to the time of laying. The burrow, which is seldom deep or long, is generally situated amongst the flax, or on the open ground where it is sufficiently soft and free from stones. On the 27th June, 1888, I examined sixteen burrows, and in thirteen of these found a bird, each sitting on a fresh-laid egg; the other three nests contained each two birds, but no egg. No eggs having been found previous to the 24th, it may be assumed that most of the laying occurs during the last week of June. The young, which are greyish-black when in down, begin to leave during the last week of December, and by the 7th of January all but a few stragglers have departed. The young, when handled, often eject their food, which I find to consist of Medusæ and minute shrimps, but I have seen no trace of fish, excepting in December, when eyeballs, like those found in the stomach of *Puffinus tristis*, are sometimes thrown up. In December, 1886, I saw an albino of *P. gouldi*. It was a young bird of a uniform dirty-white colour, and had been found by a Maori, who kept it till I saw it. I am told by the Maoris that they usually find one or two every year amongst the thousands of young birds captured; but the specimen referred to is the only one I have seen. This species used to strike the lantern in great numbers, but rarely does so now. In December, 1888, the natives potted 3,000 young birds, taken off Mokohinou and Fanal Islands.

Prion banksii.

Does not breed here, but three years ago I secured a specimen which struck the lantern.

Thalassidroma melanogaster.

So far as I have been able to discover, this species does not breed here. In 1886 Mr. W. R. Wilson (now at Ponui Lighthouse) caught a specimen which flew against the lantern. It is the only one I have seen.

Thalassidroma fregata.

Confines itself to one of the low islands, where it breeds in considerable numbers, the nests being as close together as the ground will permit. Burrowing begins during August, both birds being engaged in the work, which is carried on during the day for the last month previous to laying. Nesting-material, of which a comparatively large amount is used, is collected during the first half of October; laying begins in the middle of the same month, and is over by the 1st November. The egg, of which one only is deposited in each nest, is white, with more or less reddish specks at the blunt end, or sometimes disposed in a band. The eggs are rather variable in size, and the following measurements were taken from the smallest and largest of many examples: Length, 1·3in.; width, 0·94in.: length, 1·44in.; width, 1·7in. The young in down are greyish-black, but when taking their departure, during the last week of February and first week of March, can scarce be distinguished from the old birds. During thick weather in the breeding-season a great number fly against the lantern or come in at the light-room door.

Dysporus serrator.

Often seen, but does not breed in the vicinity.

Phalacrocorax novæ-hollandiæ.

Common. Does not breed here.

Eudyptula undina.

Breeds on the Mokohinou Islands, but not in great numbers. Examined several burrows in the middle of June, and found two birds in each, burrowing. Again, a month later, and found that the birds had deposited dry rubbish in the burrow. On the 15th August I found several nests with one or two eggs in each, and others again, a fortnight later, also with eggs quite fresh. The young leave in the end of December and first half of January. In dry or stony places little, if any, nesting-material is used unless it is found very close at hand, and any suitable hollow or crevice in the rocks,

out of reach of the sea, is generally taken possession of. On the other hand, nests are occasionally found a couple of hundred feet above the water, but only, I think, when suitable places cannot be found at a lower level. On one occasion I witnessed a fight between this penguin and a *Procellaria gouldi* about a burrow. Leaving them to settle the question, and visiting the spot again a few days later, I found the penguin dead outside the burrow, and the *Procellaria* in possession.

The old burrows are used again year after year, but are invariably renovated and extended, and I am of opinion that the same birds return to the old nest if they were left undisturbed previous to and during the time of incubation. If the eggs are removed, or the old birds disturbed, the burrow is deserted, and generally remains without a tenant for that breeding-season; and this applies to all the petrels mentioned above. The penguin, on the other hand, does not readily leave its nest or burrow, for I have seen the bird laying a third time in the nest from which I had on two previous occasions removed the eggs when the bird was absent. In the case of the petrels, the laying-season varies from a week to a fortnight during different years. A dry winter is followed by early laying, but a wet winter retards the burrowing, and consequently also the laying, for the birds are unable to "back out" the loosened earth if wet. The laying-times given above must therefore be taken as applying to a dry winter and spring.

I am informed that punishment, such as a tap on the head and confiscation of the offender's birds, was in the olden time inflicted by the chief of the hapu then residing on Mokohinou on such of his people who, accidentally or wilfully, broke the holes whilst collecting the young oii. The killing of an old bird was considered a still more serious offence.

Before concluding my notes on the birds I will give a list of such introduced species as have come under my notice:—

Birds introduced by European Settlers.

Sparrow: Breeds on the lighthouse island.

Goldfinch: Gradually-increasing numbers visit yearly in June. This year (1888) I saw a dozen which remained for three weeks.

Yellowhammer: Visits occasionally in small flocks.

Skylark: One or two pairs remain at the island.

Quail (Australian): One or two visit occasionally.

ART. XXXIII.—*Notes on a Paper entitled "The Takahe in Western Otago," by Mr. James Park, F.G.S.*

By E. MELLAND.

[*Read before the Otago Institute, 12th August, 1889.*]

IN the current volume (xxi.) of the "Transactions and Proceedings of the New Zealand Institute" there is an article on the *Notornis mantelli*, entitled "The Takahe in Western Otago," which I think ought not to be passed over without some sort of protest; and in case no one better fitted for the task should consider it worthy of any notice I have resolved to say a few words about it.

The writer of the article is Mr. James Park, F.G.S., and his object is to show that the takahe "not only exists, but is probably as numerous now as when the colony was first settled by Europeans."

In his introductory remarks about the known specimens of this bird Mr. Park is not as accurate as could be wished. With regard to the one generally known as the Dresden specimen he says, "The third specimen was captured by a party of rabbiters, about the beginning of 1880, on the Mararoa Flat;" whereas it was caught by a solitary rabbiter towards the end of 1879 on a piece of ground locally known as "The Wilderness," some distance from the Mararoa Flat. The place is accurately described by Professor Parker in his article on the Dunedin specimen in vol. xviii. of the "Transactions." But Mr. Park has apparently never seen this article, nor heard of the existence of this skeleton, for he goes on to say, "Since the above date"—*i.e.*, 1880—"no fresh example of the *Notornis* has been secured."

He then begins the narrative of his own experiences with, "My first acquaintance with this bird dates back to 1881." This "acquaintance" consisted in Mr. Park and two companions, who were camped among the mountains in the Wanaka district, hearing, soon after dark, "at short intervals, a loud booming note." As they "were all pretty familiar with the calls of the different birds usually met with in the high lands of Otago," they arrived at the conclusion, "after some deliberation," that this was the *Notornis*—"a determination," he goes on to say, "subsequently borne out by facts which came under my own observation."

What these convincing facts were we shall see later on. We are then told how they tried to catch sight of the bird by the light of the camp-fire, but were unsuccessful. The next day Mr. Park "found that the clear space below the matted

branches of the scrub under which the bird had eluded us was about 20in. high, thus affording a means of approximately determining its height." I should have supposed that this merely proved that the bird was less than 20in. high, and did not, even approximately, determine how much less; but Mr. Park's ideas of evidence are peculiar. Having now no doubt whatever on the matter, he goes on to say, "The *Notornis* remained in the vicinity of the camp during our stay at this place, being evidently more curious than alarmed at our presence. He generally sallied forth at dusk and retired at daybreak."

With regard to the assumed nocturnal habits of the takahe, I may say that what little evidence there is on the subject is all against the assumption. At least two of the three specimens caught alive were found and run down in broad daylight.

Mr. Park's next experience occurred a few days later, when camped on the Matukituki with the same party. Shortly after dusk they "heard the note of a *Notornis*" (this assumption of certainty runs through the whole article), and this time they disturbed the bird, though they did not see it; but they saw the "shallow hole in the dry sand" where the bird had been dusting itself.

The following evening Mr. Park was more fortunate, and, looking cautiously over the bank, actually caught a passing view of the bird, though we are not informed at what distance. He admits that "in the uncertain starlight" he could "only make out its general outline," and that "it must be remembered that it was only in sight a few seconds;" but the "impression it left on" his "mind at the time was that its colour was very dark and its height about that of a full-grown turkey." As to this, I need only say that, as Mr. Park was quite certain he was about to see a takahe, and then saw something under the very untrustworthy conditions he describes, it would have been strange if the impression left on his mind had been anything else.

Mr. Park then relates how, seven years later (in January of last year), he was in Dusky Sound, and heard "the *Notornis*" on several occasions—so often, indeed, that, if the mysterious notes had really been due to takahes, these birds must be about as common on the West Coast as kiwis. He was, however, never again fortunate enough to see one. The next piece of evidence is that of Mr. Park's "field-hand," who also "heard a takahe in the bush," and recognised the booming note at once, as he had been "one of the party of rabbiters who caught the takahe near Lake Te Anau in 1880," and had there often heard the note. Mr. Park sublimely adds, "I considered this evidence conclusive that this was indeed the *Notornis*." This conclusive evidence is, however, a little

shaken by the fact that the 1880 (or 1879) takahe was caught, as I said before, by a single rabbiter, and not by a party (this man's name was "Bob Scott;" the name of Mr. Park's assistant is not given); and, secondly, by the very strong suspicion that the booming note the man had so often heard was simply that of the bittern, a bird far from uncommon in the Mararoa district.

Mr. Park then proceeds to sum up our knowledge of the takahe by adding his experiences to the list of captured specimens, as if the evidence was all of the same value. He then quotes Mr. Docherty, who recently informed the Hon. Mr. Mantell that he had seen a *Notornis* at Dusky Sound. "He said he came upon it in the bush close to the beach, and that it flew some distance on to the water, and then made back to the shore." By quoting this remarkable statement without a word of comment Mr. Park lays himself open to the suspicion of believing the *Notornis* to be a bird capable of sustained flight. Without going into the anatomical aspect of the question, I would simply point out that both the takahes whose capture is recorded in detail were run down by dogs after a long chase, and both could have escaped had they possessed the power of flight.

Mr. Park confidently concludes with the remark, "I think I have said enough to show that the *Notornis* still exists in the lonely sounds and mountain-recesses of Western Otago."

I would rather say that the article, by its whole tone—so alien from the cautious true scientific spirit—only shows how easy it is for some men to prove to their own satisfaction anything they may strongly wish to believe. The mere fact that the indefatigable Mr. Reischek has been industriously searching for the takahe in the very district mentioned for many months without success might have given Mr. Park some doubt as to the truth of his theory. So might Mr. Mantell's account of the first takahe, caught at Resolution Island. This bird was kept alive on board ship for three or four days, and is said to have "uttered loud screams," but no mention is made of anything of the nature of a booming note. This is, of course, merely negative evidence, though not, I think, without some value.

It is usually very difficult to prove a negative, but in this case the matter is simplified by the ease with which we can prove a contradictory affirmative.

On the occasion when Mr. Park almost saw the author of the booming note in its dusting-hole, he regretted that he had not with him "a sharp dog," which could "easily have caught it."

It certainly is a matter for regret, because the dog would have surprised its master by bringing him a kakapo, and

then I suppose the article under notice would never have been written. Mr. Park's description of this mysterious booming note, very much like that of the bittern, but louder, exactly describes a note of the male kakapo (*Stringops habroptilus*) in the breeding-season; and, if Mr. Park had only had a dog with him in camp, or if he had made some inquiries on the subject in the Te Anau district, for instance, he could easily have satisfied himself of this fact.

The peculiarity of the male kakapo having a special and remarkable note for the breeding-season is possibly due to its supposed polygamous habits. Mr. Richard Henry, who has lived in the Manapouri and Te Anau district for about ten years, and is a very careful and trustworthy observer of facts connected with natural history, and also an energetic collector, says, "I have never found two (adults) in one hole at any season, though there is always plenty of room, so I conclude that they never pair, but are polygamous, and that the booming is music to the female, the finest boomer being the greatest charmer." On this point I would suggest that this warlike note is more probably intended for other males, and is a defiance or a challenge to mortal combat. This would in some measure account for the infrequency of the note excepting where kakapos are very plentiful. With regard to the question of polygamous habits, I find that Mr. Reischek, in some notes on the kakapo, says,* "From my observations, I am of opinion that the male bird takes no part in the hatching or rearing of the chicks, as in all cases the female was the sole attendant from first to last. I did not see a male near a breeding-burrow, nor did I in any single instance find two grown-up birds in one burrow, though I have seen them in pairs on their nocturnal rambles. Whenever two males meet they fight, the death of the weaker sometimes resulting."

These observations certainly appear to support the theory of polygamy; but this is at present a secondary matter. On the main question as to what bird is responsible for this powerful and alarming sound—which I have heard across the still waters of Te Anau at a distance of five or six miles—there can be no doubt. Some years ago Mr. R. Henry may be said to have settled the matter by systematic hunting for the then unknown bird among the mountains on the west shore of Te Anau. The mystery was very easily solved. When within a few yards of the "boomer" he would let his dog go, and the invariable result was an adult male kakapo. Since then he has many a time verified his conclusions, and any one who is interested in the question, and will take the necessary trouble, can easily do the same.

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* "Trans.," vol. xvii., p. 195.

In case it should be thought strange that such an unusual note should be due to such a comparatively common bird as the kakapo, I should mention that, in addition to the fact that this note is only used during the breeding-season—from November to January, with an occasional "boom" up to as late as March (Mr. Park's experiences appear to have all been in January)—another peculiarity has been observed which shows its strangely intermittent occurrence. I cannot say whether the fact holds good on the West Coast, but on the Te Anau side of the mountains it has been carefully noticed for the last nine years that the booming note occurs only every alternate year. In these years the "drumming" (as it is called) can be heard in all directions almost every night of the breeding-season, while in the intervening summers there is hardly a solitary "boom." From this observation a theory has been evolved that the kakapo only breeds every alternate year. If true, this would no doubt be a remarkable and noteworthy fact; but there is not yet sufficient evidence either to prove or disprove it. It seems a pity that no systematic steps have been taken to definitely settle a question so easily decided, the more especially as, owing to the incredible folly of the Government in turning out ferrets on the west shore of Lake Manapouri, the day when this and all similar questions with regard to the native birds in that district will be impossible of settlement, is rapidly approaching. At present, however, the ferrets have not passed the South Fiord of Te Anau, and between there and the North Fiord I would undertake to catch at least half-a-dozen drumming kakapos any night next December. This is the sunny side of the mountains, and still has, I believe, far more kakapos to the square mile than any other part of the West Coast.

Before leaving the subject of this mysterious booming note I must quote from Sir Walter Buller's article on the kakapo, in the new edition of his "Birds of New Zealand," a curious remark which seems to show that in the olden days the Maoris had traced this sound to its true source. He says (vol. ii., p. 181), "The Maori proverb, '*Ka puru a putaihinu*,' relates to the former abundance of this bird. The natives say that the kakapo is gregarious, and that when in the olden time numbers of them congregated at night their noise could be heard to a considerable distance. Hence the application of the above proverb, which is used to denote the rumbling of distant thunder." As there is not the slightest connection between the ordinary strident scream of the kakapo and the "rumbling of distant thunder," this saying seems to distinctly point to the "drumming" note, which at a considerable distance is not at all unlike rolling thunder. But the origin of the proverb is by this time probably unknown to the Maoris

themselves, since the kakapo is practically extinct in the North Island, while the Maoris are almost equally scarce in the kakapo districts of the South.

To return to Mr. Park's article, I must add that if the writer had been at all well acquainted with the habits of the kakapo he would at once have suspected who was his nightly visitant. Besides the fact that there are so few birds of any size in our New Zealand bush that confusion on the subject is all the more inexcusable, Mr. Park's description of the mysterious bird's behaviour at the camp-fire is the common experience of every one accustomed to camping in bush where the kakapo is plentiful. I have often, when camped out on the West Coast mountains, been obliged to tie the dogs up all night to save these birds, while visiting our fires, from being uselessly killed. Again, the incident of the unknown bird having been dusting itself in a "shallow hole in the sand" should at once have suggested the real truth of the matter to any West Coast bushman. This is one of the common habits of the kakapo, and these dusting-holes are often the first signs of the presence of these birds in the bush. Then, the nature of the country, and the time of day—or night—in which Mr. Park's adventures occurred, are exactly suited to the habits of the kakapo.

But perhaps I need say no more. Some may object that I have already paid more attention to this article than it deserves. But, however harmless at present, in years to come, when most of our native birds are extinct, and when it is therefore too late to disprove Mr. Park's conclusions, these confident assertions might seriously mislead future students of such subjects. To me it seems a grave misfortune that such a careless, erroneous, and illogical paper should ever have attained to such a position of importance and permanence as is assured by its being admitted into what is generally supposed to be a scientific publication.

Art. XXXIV.—*On the Habits of the New Zealand Bush-rat* (Mus maorium).

By Joshua Rutland.
Communicated by Professor Hutton.

[*Read before the Philosophical Institute of Canterbury, 2nd May, 1889.*]

The countless swarms of rats that periodically make their appearance in the bush country of the South Island, though casually noticed by the settlers ever since the founding of the colony, have not until recently attracted the attention of

accurate observers; consequently data are not now procurable from which a satisfactory conclusion may be arrived at as to the cause of this curious phenomenon.

Having witnessed two of these swarms, and carefully collected evidence from various sources, I now give the results, hoping that they may be found useful whenever this chapter in our natural history shall be more completely written.

Prior to the clearing of the land on which the city of Nelson now stands, one (or more) of these rat-swarms was there observed by the early settlers. In 1856 the district of Collingwood, on the western side of Blind Bay, was visited by a swarm; and, in 1863, I am informed of a swarm on the Shotover, Otago. But it is from the town of Picton that I have collected the best information. There, repeated swarms have been observed by the old residents. Unfortunately, I have been unable to ascertain the dates of occurrence excepting in four instances—namely, 1872, 1880, 1884, and the present spring (1888). From these dates it would appear that periods of about four years intervened between the swarms. Though I cannot discover that any had taken place in Picton during the eight years between 1872 and 1880, this may be accounted for by the fact that the swarms are not always generally diffused, but sometimes miss certain localities. Thus, in the Pelorus Valley, during the twenty-four years preceding 1884 these rats in any great numbers were not observed, though I am satisfied that previously swarms had here occurred, for shortly after my settling here in 1860 I was informed by the Maoris that during certain seasons immense numbers of rats made their appearance, destroying the crops—or, as they put it, "cutting the corn down all the same as with a sickle." In like manner, in 1884, while Picton and the surrounding district were swarmed with rats, at The Rocks, on the opposite side of Queen Charlotte Sound, none, or very few, made their appearance, though I am informed that during a previous swarm this locality was visited like other places.

These rat-swarms invariably take place during spring. In August a few of the little animals appear; as the weather grows warmer they gradually increase in number until November, when all disappear again gradually, as they came.

While in a locality dead rats are seen lying about in all directions—on roads, in gardens, and elsewhere. Very few have any marks of violence on their bodies; nor can it be supposed that they have died of hunger, since on examination they are generally found fat. In Picton, during the swarm of 1884, the stench becoming unbearable in one of the houses, the floor of the sitting-room was removed, when forty-seven

rats were found lying together dead near the fireplace. In another house on the opposite side of the same street thirty-seven were found under the floor of the kitchen. Indeed, the whole town was pervaded with the odour of dead rats. It took the place of pastille in the drawing-rooms, and overpowered that of sanctity, even, in the churches.

In size and general appearance the bush-rat differs much from the common brown rat. The average weight of full-grown specimens is about 2oz. The fur on the upper portions of the body is dark-brown, inclining to black; on the lower portions white or greyish-white. The head is shorter, the snout not so sharp, and the countenance milder, or less fierce, than in the brown species. In 1884 and during the present year numbers of these animals were to be seen with their tails more or less mutilated and diseased.

On the open ground the bush-rat moves comparatively slowly, evidently finding much difficulty in surmounting clods and other impedimenta; hence they are easily taken and destroyed. In running they do not arch the back as much as the brown rat. This awkwardness on the ground is at once exchanged for extreme activity when climbing trees. These they ascend with the nimbleness of flies, running out to the very extremities of the branches with amazing quickness; hence, when pursued they invariably make to trees if any are within reach. The instinct which impels them to seek safety by leaving the ground was curiously illustrated here this season: a rat, on being disturbed by a plough, ran for awhile before the moving implement, and then up the horse-reins, which were dragging along the ground. Another peculiarity of these animals is that when suddenly startled or pursued they cry out with fear, thus betraying their whereabouts, an indiscretion of which the common rat is never guilty.

While the rats were about the Pelorus Valley in 1884, and again in the present year, many nests were found evidently constructed by them. These nests, which are built of fine grass, leaves, and other soft materials, are placed under the roots of trees, amongst rushes, and not infrequently in the crowns of tree-ferns; but for what purpose they are intended I do not know—as far as I have been able to ascertain, young ones have never been found in them.

The extremely few females that occur amongst the countless hordes is a fact that shows that if breeding does take place at all during these periods it must be on a very limited scale.

Besides these nests there are to be found, lying on the ground in the shade of the bush, the hollow trunks of fern-trees containing quantities of the stones of the hinau fruit, each stone having a small hole pierced in the side, through

which the kernel has been abstracted. This is the work of the bush-rats, but I am not inclined to think that it is all done during the periods of swarming above referred to.

Considering the vast numbers of these rats that periodically congregate round the homes of settlers in the bush, the mischief done by them is extremely small. This is owing to their food during the time being green vegetables. In kitchen-gardens they are certainly annoying, devouring peas, beans, cabbages, and even onions, as they appear above ground, climbing hop-poles to nip off the shoots of the vines, and making a clean sweep of the strawberry-crop long before the fruit is ripe. Though they enter dwelling-houses and barns, it is evidently not in quest of food, as shown by corn and other eatables being left untouched by them.

When lately making inquiries whether these rats were on the new Mahakipawa Goldfield, I was told they were there in thousands, running over everything; "but," added my informant, "they are harmless—they don't interfere with the flour-bags."

Such are briefly the results of my observations and inquiries concerning the habits of the bush-rats. I will now examine the various reasons that have been assigned for their periodical appearance, commencing with that given by the Maoris—namely, the failure of the kiekie fruit, causing these animals to leave the hills and seek other food. Any one acquainted with the distribution of the kiekie (*Freycinetia banksii*) in this portion of the island will at once perceive the insufficiency of this cause. Though the kiekie covers considerable areas on the hillsides and on the shores of the Sound, it is either entirely absent from the inland valleys or only occurs in patches along the sunny sides high on the hills, where it rarely flowers. I have no doubt that the kiekie fruit would be very acceptable to the bush-rats, but it can never be in sufficient quantity to form an article of food on which they would be dependent. Besides, their appearance in places where the kiekie does not occur as well as where it is plentiful points clearly to some other cause. I shall have, however, to return to this later on.

During the winter months preceding the swarm of 1884 heavy falls of snow took place throughout this district, covering the higher portions of the hills. The mixed bush of the low lands also bore a plentiful crop of fruit the previous summer. To both of these circumstances the appearance of the rats was attributed, some averring that they had been driven down from the hills by the snow, others that they had been induced to come down by the large supply of food on the low land.

I particularly noticed the recurrence of the two conditions in 1887—an abundant crop of fruit throughout the mixed bush,

followed in season by heavy falls of snow on the surrounding hills: but no swarm of rats visited the locality in the succeeding spring: whereas this year, after an unusually mild winter—sufficient snow to whiten our hill-tops not having once fallen—and the crop of fruit on the low lands being very moderate, the rats have made their appearance precisely as they did in 1884.

The most generally-received explanation of the periodical appearance of the bush-rats in the northern portions of this island is that they migrate hither from a more southerly district. Hearing that Kaikoura is supposed to be their place of departure, I made particular inquiries, and find that the animal is unknown there—at least, on the seaward side of the range.

Putting aside the question from exactly whence these rats come, I will take one of the natural subdivisions of the County of Sounds, and examine what takes place there during the periods of swarming, and how far it coincides with the migratory theory.

The curiously irregular block of land that divides the waters of the Pelorus and Queen Charlotte Sounds, and in which Mount Stokes forms a prominent feature, contains numerous small valleys or groups of valleys, separated from each other by rugged wooded ranges rarely less than 1,000ft. in elevation. The only connection this district has with the mainland is the long, narrow mountain-ridge that forms the southern shores of the Kenepuru Reach. Where the public road crosses this ridge, from the head of Torea Bay, in Queen Charlotte Sound, to Portage Bay, in Kenepuru, is a low saddle about 400ft. high, the distance between the two waters being only about 40 chains. The land here is mostly in grass, and is occupied by a settler's family. During the spring of 1884, while the bush-rats were so numerous in Picton, and in the Pelorus, Kaituna, and other inland valleys, they were equally numerous in the valleys round Mount Stokes before mentioned. Now, supposing the migratory theory to be correct, the whole of the vast throng of animals must have found their way thither over the narrow neck of land between Portage and Torea Bays, must have crossed the public road, and must have passed the homes of the people there settled; but no such movement was by any one observed. Indeed, one fact which I carefully verified this spring seems to me irreconcilable with the migratory theory. It is the simultaneous appearance of the rats in this isolated portion of the County of Sounds and in certain inland valleys to the south.

Early last August, noticing that the rats were coming about the low land on the north bank of the Pelorus River, and having occasion at the time to visit Kenepuru, I made

inquiries immediately on my arrival, and obtained positive evidence that the rats commenced making their appearance there at the same time as they did in the Pelorus. Considering the geographical position of the two localities, I can hardly see how this could take place if the animals came from the more southerly portions of the Island. During the three months the rats remain on the low lands of the bush country they certainly have no appearance of travelling in any particular direction, but merely wander about like animals in quest of food.

In the early part of November, while the rats were so numerous in the Pelorus Valley, one was observed evening after evening for about three weeks coming out from among the flowers in my garden, climbing a rose-tree that grows against the verandah-post, and making his way along the wall-plate to the roof of the building. This took place with such regularity as to leave no doubt of its being the same individual. I mention this as it plainly shows that these animals are not always mere passers-by.

It may now be very reasonably asked, What, then, is the cause of the periodical appearance of the bush-rats?

To this question I shall not attempt any definite reply, as I do not consider the information at my command sufficient to warrant my so doing. There are, however, certain circumstances which seem to suggest a solution of the problem; and to these I shall now refer. Generally, if not always, accompanying these rat-swarms are large flocks of parroquets. On the outskirts of the bush, as in Picton, the Tuamarina, &c., these birds make their appearance a month or so later than the rats; but within the bush country they appear simultaneously, or, if there is any difference in the dates of arrival, the parroquets are first noticed. Although the parroquets only appear here periodically in large numbers, the bush is never without them, and this remark is equally applicable to the bush-rats; though, owing to their habits and being less conspicuous, they are not so generally observed. Every spring a few of these little animals may be seen on the open tracts within the bush country, and even during the twenty years wherein no swarm took place in the Pelorus Valley they were frequently observed, but not in sufficient numbers to attract much attention.

Another instance of the appearance in large numbers of animals generally scarce is furnished by the mosquitoes of the Pelorus Valley. A few of these troublesome insects are invariably found here throughout the warm season. Every now and then immense swarms appear. These swarms, which occur sometimes in spring, sometimes in autumn, are undoubtedly due to the occurrence of conditions favourable for

their increase; and it seems to me that it is in the working of this same law that an explanation of the periodical appearance of both the rats and parroquets will be found.

During the summer and autumn preceding the great swarm of 1884, while moving about various portions of the bush country, I noticed that the nests of parroquets were unusually numerous. Everywhere I went people had the unfortunate young birds confined in cages, for what they grimly termed "pets." A similar abundance of nests was again observed last year, preceding the swarms of parroquets and rats which have just taken place.

A supply of food being the most important of the conditions necessary to the increase of the higher or viviparous animals, and the rats being herbivorous, we naturally turn to the productions of our forests when seeking an explanation of their periodical appearance on the above-mentioned basis. Here we are at once confronted with the facts that the swarms of 1884 and of the present year followed after heavy crops of fruit throughout our beech-forests, and that such exceptional crops are produced at intervals, both by the more homogeneous beech-forest and the mixed bush of the low lands, though they are not always coincident. That the upper portions of our hills, which are mostly clothed with the various species of beech, are the proper habitat of the bush-rat, I think there can be little doubt. One hill in this district bears the name of Kaikiore, the tradition connected therewith being that some natives, while hiding from their enemies, subsisted on rats, which they found in great numbers; and this, again, I think, accounts for the statements made by the Maoris that the appearance of these rats on the low lands is due to their being compelled to leave the hills through the failure of the kiekie fruit; for, though I consider the cause insufficient, it must often be coincident with the period of swarm.

While venturing the above suggestions, I clearly perceive that no explanation can be deemed satisfactory that leaves the enormous preponderance of males in these rat-swarms unaccounted for. Amongst English country-people, who have the best opportunity of observing them, it is commonly asserted that in litters of young rats the males produced outnumber the females by about seven to one. Whether this is correct, or, if correct, whether it holds good of all the species of the genus *Mus*, I do not know; but, even if it is the fact, it would be insufficient to account for the disproportion of the sexes found in our rat-swarms.

Two questions here present themselves: (1.) Would a sudden increase of numbers, consequent on an excessive food-supply, affect the usual proportion of the sexes? In the case of the hive-bee, whether a nymph shall develope into a barren

worker or a fertile queen is determined by the food given. (2.) Is the preponderance of males due to a separation of the sexes through these animals having to extend their range in quest of food? To these questions further observation can alone furnish replies.

NOTE BY PROFESSOR HUTTON.

Measurements.—The Maori rat is smaller than either of the other two rats found in New Zealand, and the female is rather smaller than the male. The following are measurements of three individuals of each sex, given in inches:—

	♂	♂	♂	♀	♀	♀
Snout to root of tail ..	4·85	4·6	4·5	4·8	4·7	4·5
Length of tail	4·85	5·4	5·5	4·5	4·6	4·6
Total length	9·7	10·0	10·0	9·3	9·3	9·1

The difference is thus seen to depend on the length of the tail, which is shorter in the female than in the male.

The other dimensions are: Length of head, 1·5in.; breadth of head between the ears, 0·6in.; length of ear, 0·6in.; breadth, 0·45in.; length from nose to ear, 1·3in.; length of hind foot 1in., of fore foot 0·5in., inclusive of claws. All the toes have claws.

Colours.—In colour they much resemble the common brown rat. The upper surface of the head and body is brown, finely mottled with dark-grey. This is due to the hairs, some of which are nearly black, but most are dark-grey at the base, broadly tipped with reddish-brown. The sides of the body are lighter, and all the under-parts, including the chin and feet, are dirty-white. The fur is slate-blue. The tail is scaly and sparsely covered with short hairs, which are black on the upper surface and grey on the lower. Ears rather large and rounded at the tip, yellowish-brown, with minute grey hairs on both surfaces. Hairs of moustache, most black, some white; length, 1·75in. Upper incisors orange, lower yellow. Legs and feet yellow, with short white hairs; the hind feet with small tufts at the end, projecting over the nails.

In 1884 Mr. Rutland sent me four heads of this rat. Two are coloured as described above, but the other two are lighter in colour and redder. One has brownish-red hairs on the cheeks only, the rest being reddish-brown; but the other is entirely brownish-red, quite foxy in colour over the upper surface of the head and neck. This may be a distinct species.

Art. XXXV.—*Rabbit-disease in the South Wairarapa.*

By Coleman Phillips.

[*Read before the Wellington Philosophical Society, 2nd October, 1889.*]

Professor Thomas has finished his full report upon the parasitic diseases affecting rabbits in the Wairarapa district, and it has been presented to Parliament. It is to be regretted that the paper cannot be included in the "Transactions" of this Institute. As a zoological paper it is an excellent one, and had Professor Thomas confined himself to that aspect of the question I should have been the last person to take exception to it. But his analogies, deductions, and summaries are quite wrong and misleading. It is to prevent the harm that they must do that I venture to criticize his report. He must kindly excuse my doing so.

In the beginning of the report and at its conclusion Professor Thomas emphatically says that "the most valuable measures taken to reduce the pest have been winter poisoning and trapping," &c. All I can say in reply is that in the North Wairarapa, where poisoning and trapping have been relied upon, the rabbits are worse now than ever they were. Trapping, indeed, is a most fatal mistake. We never resorted to it, but carefully avoided it, in the South Wairarapa when we conquered the pest during the years 1884–87.

With regard to bladder-worm, Professor Thomas regards it only as a "minor and auxiliary means of destruction," "although it may be usefully employed against the rabbit-pest."* "The employment of liver-coccidea for the destruction of rabbits cannot be advocated;" "but the disease may be of further use in killing rabbits." (There is a confusion here which can only result from Professor Thomas's non-acquaintance with the practical working of rabbit-suppression.) Rabbit-scab (the louse-mite—*Sarcoptes cuniculi*) and the rabbit-louse (*Haematopinus ventricosus*)—two diseases— are dismissed as of no practical importance whatever. Yet each one of these four diseases was upon my run and in my district, and to them as much as to any other of the remedies used I ascribe the magical disappearance of rabbits in South Wairarapa in 1885–86 and the conquest of the pest. The other remedies we used were—(1) simultaneous action through a voluntary Local Board of Government; (2) winter poisoning; (3) the turning-out of the natural enemy (cats, ferrets, stoats, and

* I must say that I found this disease most useful in enabling me to conquer the pest and keep it at its minimum, as I shall show later on.

weasels; hawks being also most useful); (4) the steady hunting with dogs.

I am glad to note that Professor Thomas makes no mention of rabbit-fencing whatever in his report. This remedy, which captivates superficial minds, I never used, and have no faith in. It affords a temporary stop against the rabbit, but it is most harmful in causing settlers to rely upon its efficacy in place of taking proper and active measures against the pest. Whenever a settler resorts to rabbit-fencing I know that the rabbits are to be preserved in his district. It is no remedy whatever against the pest. All the good it affords is a selfish and temporary protection. Hundreds of thousands of pounds are being expended upon it throughout the Australasian Colonies, whereas one-tenth of the money properly applied would give far more effectual relief. I mean by this the introduction of the natural enemy and spread of the diseases above named.

I cannot add much to Professor Thomas's zoological work. That I think excellent, except in the one thing—viz., his experiments with the ferret. My opinion is that the ferret is a wormy animal, and I should like to see further experiments tried in the direction of feeding it with the proglottides (tapeworm-ends).

Professor Thomas takes exception to Sir James Hector's statement ("Trans.," vol. xx., p. 457) that "in America he had seen large tracts of country cleared of rabbits in a few months by the propagation of this disease—bladder-worm," and in support of his view he says that " the statements made by Mr. C. N. Bell, of Winnipeg, do not bear out any such idea." I should feel favoured by Sir James Hector stating now what he actually did say. I believe our worthy Director furnished our Government with a paper upon the rabbit question many years ago. I should be glad to see it included in the "Transactions" of this society.

With regard to the bladder-worm disease, I may be allowed to add here my own practical observations to Professor Thomas's scientific work. The disease certainly appears to be worse during the summer and autumn months. In winter not many bladdery rabbits are caught; but the men then are generally poisoning. As I write now, in the spring, the first small bladders are appearing attached to the liver and the big paunch of the stomach, like a little set of pendants, usually where the liver touches the stomach. They are rather pretty little pendants, like drops of cloudy water containing a worm or two—at least, that is their present appearance, although I must say that this is the first time I have noticed the bladder-worm in this form. I am not quite certain about these little sacs, but I have brought with me a specimen for members to

see this evening. The bladders subsequently come everywhere upon the muscles, some external and some internal, about 50 per cent. being internal bladders. If internal, or part internal and part external, *every other organ has to give place to them, even the genital organs totally disappearing.* Professor Thomas appears to quite overlook the fact that this disease positively stops the breeding-powers of the rabbits, *the most important desideratum for us to aim at in dealing with the rabbit difficulty.* All other measures are absolutely futile. We can sweep off the rabbits by the million with poison; but our time and money are thrown away unless we can stop the rabbits left after the poisoning from breeding up again. My rabbiter never remembers catching a doe in young afflicted with bladder-worm. I do not say that such a rabbit may not be caught so afflicted—in fact, I have heard of rabbits being so caught; but the disease certainly checks their breeding-powers. I should be sorry to be the embryo rabbit contesting existence with an internal developing bladder-worm. It is generally the buck-rabbits we catch afflicted with the bladders.

In this way Nature works. She does not sweep off by the million, as people afflicted with the rabbit-pest expect her to do, but she sends a disease that quietly stops the breeding-power. Therein lies its great beauty. The rabbits absolutely thrive and fatten under a disease that all the time prevents their future increase. M. Pasteur's plan was therefore opposed to Nature's simple working. Why the rabbit thrives and fattens under the disease is easily answered. This animal affords a wonderful food-supply to man, and for that reason Nature will not allow it to be exterminated. Nothing we can do now will exterminate the rabbit in New Zealand or Australia.

Bladder-worm was not bad upon the Dry River Run when the rabbits were thick, and poisoning and hunting were relied upon (1883–84). Then I began turning out the natural enemy, and still continuing the use of dogs. Then the bladder-worm came as the rabbits were disappearing (towards the middle of 1885), and the run was fully infected with the disease (as also with liver-rot, scab, and louse) when Professor Thomas examined it in March, 1888; the height of the disease being a year and a half previous to that, about the end of 1886. The three other diseases named were not so bad with me as the bladder-worm, or as they were upon some of my neighbours' runs. I consider from what I heard that the liver-rot did better work upon Mr. Tully's run than the bladder-worm. (Still, I think these four diseases epidemic and endemic.)

Now, as I write—September, 1889, when the run is as clear as ever it will be—we do not catch many rabbits with bladder-worm. The disease may only be developing for the summer

and winter months. But, then, my rabbiter disagrees with Professor Thomas in the matter of the use of areca-nut. He says that for the past eight months, following Professor Thomas's instructions, he has desisted from giving his dogs areca-nut, and there is not nearly so much bladder-worm on the run now as when he used to give the dogs monthly doses of the medicine. He thinks that the disease did not appear at all upon Dry River until about six months after I had insisted upon his keeping the dogs in better condition than they were, and his using some kind of purgative to expel their worms. (That was early in 1885. See my paper, "Trans.," vol. xxi., p. 430 *et seq.*) It is difficult for me to be certain as to exact dates now, as we never kept a strict record of the appearance and course of these diseases. In my first paper I thought 1886 was the year when we first began using the medicine, but my rabbiter thinks now that it was in 1885.

As to the other natural diseases referred to, and discarded by Professor Thomas as being of no use, we have had, and still have, liver-rot, scab, and lice amongst the rabbits. And I should advise every other runholder to see to the spread of these diseases, just the same as, if he wished to reduce his sheep, he would not dip, and would so allow their scab to spread; not pare and use the arsenic-trough, and so allow foot-rot to spread; not shift and attend to his hoggets, and so allow lungworm to spread. These sheep and rabbit diseases I have mentioned are Nature's simple remedies against excessive increase, and our duty is to use and spread them if we desire to conquer the rabbit-pest. Therein lies our remedy, not in cholera-microbe solution. Nature never used cholera-microbes against the excessive increase of the rabbit. The Royal Commission in Sydney has made a capital blunder in overlooking these simple diseases which I pointed out, and seeking, with M. Pasteur's aid, for something new. There is nothing new under the sun. We shall not improve upon Nature's plan of decimation by disease. Slow, steady, and sure are these simple diseases. In this consists their great beauty. Let any runholder think for one moment of the state his sheep would get into if he allowed scab, lice, ticks, foot-rot, and lungworm to spread unchecked amongst them. His yearly increase would soon be at an end, and his flock would actually diminish in numbers.

Scabby rabbits can be spread from run to run. Bladder-worm is easily spread in the daily hunting which must be done. (For it is a complete mistake to suppose that even natural enemies will keep the rabbits down. They will not entirely do so.) Liver-rot can be spread. Professor Thomas or Sir James Hector can tell us how this can be best done. All these

diseases are most important and useful (not minor and auxiliary) in checking the breeding-powers of the rabbit. They act, as it were, as the last nail in the coffin. They do not sweep off their millions. I never claimed that they did. All they do is to keep the "minimum-of-safety stage" at its minimum.

I am told of an instance of a large runholder in the South Island who went to great expense in turning out ferrets, stoats, and weasels. These animals did not do the good he expected. He consequently resorted to trapping quite lately as a remedy. My opinion is that he had far better have resorted to the spread of my four diseases, as an aid to the natural enemy, and keeping the "minimum-of-safety stage" at its lowest. Of course I do not know *how* he turned out his ferrets, stoats, and weasels—whether he acted like a fellow-settler of mine (Mr. Riddiford), who turned out twelve hundred pounds' worth of stoats and weasels three or four years ago, and thought that that was all he had to do on 50,000 acres of land. Of course these stoats and weasels scattered themselves all over the country, and he should have imported more. I turn out the natural enemy *every year* (ferrets). There is a proper way to do even this. Settlers in New Zealand have only played with the question of turning out the natural enemy as yet. Every person afflicted with rabbits must turn out a certain proportion of ferrets, stoats, and weasels every year, until a balance of prey upon prey is attained. Nor must he act like a large runholder in North Wairarapa, who tells me that his men have trapped seventy ferrets within the last two years. Traps must not be used.

Natural enemies are therefore most useful. So are hunting, poisoning, the digging-out of burrows, &c. The harmful things are trapping, fumigating, and relying solely upon poisoning and rabbit-fencing. These things will never reduce the pest; and yet Professor Thomas thinks that winter poisoning and trapping will do so.

Trapping, of course, is fatal to reduction. That should be made a penal offence in these colonies. I would much rather see a bad piece of bush country rabbity than cleared by traps. Far better is it to leave it until the next poisoning, and after that remedy has been applied to turn out a greater number of natural enemies in that particular spot. For there is a right way and a wrong way to kill rabbits. The object to be aimed at is not mere killing and visible reduction, but so killing that the numbers will not breed up quickly again. No worse mistake could be committed, in the present condition of the Australasian Colonies, when we desire to breed up the natural enemy, than the visible reduction of rabbits caused by laying traps in a piece of country covered with logs, or near old warrens or watercourses. The ground-vermin which are

certain to be there, if they have been turned out, are greatly injured, if not killed outright, by the traps, and then there is no check to the rabbits breeding up again in that particular spot. Will any person in his senses say that a doe-ferret in young is not greatly injured by being caught in a trap? It is the increase of these natural enemies that we must aim at.

Poison certainly does great good and injures very little. But certain rabbits go through the poisoning, and come out harder and stronger than ever. This is always the case; so that more than one sharp winter poisoning in a year is highly injudicious. Summer poisoning is a wrong way to kill rabbits, as this method simply doubles the number of rabbits that become poison-proof. This only shows Nature's wonderful law of preservation—that it is impossible for us to exterminate the rabbit now that it is here. With all the density of their populations, neither Europe, Asia, Africa, nor America has been able to exterminate the rabbit. Professor Thomas is quite wrong, therefore, I regret to say, when he says that population will reduce the pest. A great population is the friend of the rabbit, strange to say, and the rabbit in return affords that population a great food-supply. In densely-populated Belgium the rabbits are numerous, also in England, Prussia, France. There is a far greater chance of rabbits being swept off, say, in North or South America, where there is little population, and wolves, lynxes, and foxes roam about and scatter their virulent tapeworms—far more fatal than the dog-worm. But population clears off the wolves, lynxes, and foxes, and the rabbit flourishes and skips about, and rather defies the stoat, ferret, and weasel. At all events he is a match for these three latter animals, and a very even balance is preserved. But the rabbit is no match, as Sir James Hector points out, against the tapeworm of the wolf, fox, or lynx of North or South America. Every now and again, as the Indians say, the rabbits are decimated by the bladder-worm disease: their dead bodies strew the whole face of the country, none even being left for food; so that even good Dame Nature can be sharp enough if the occasion demands it.

Poison, of course, does good work, and no one need fear that the natural enemies suffer from it—a few may die, but not many. The great use of the natural enemy is, of course, *after* the poisoning, when they eat up the young rabbits. No dog or ferret can possibly resist a three-or-four-days-old rabbit. This is a very toothsome and delicate morsel, and is usually swallowed whole. Trapping, of course, ignores the young rabbit, and allows it to breed up again; and it assists the rabbit in doing so when it kills or injures the natural enemy. In England, if the owner of an estate wishes to preserve his rabbits he gives his gamekeeper orders to "trap off the

ground-vermin." If he wishes to reduce his rabbits the man puts away the traps, and the ground-vermin flock in from the neighbouring lands and eat up the young ones.

Australia, Tasmania, and New Zealand must be placed in an exactly similar position to England in this respect: there must be so many ground-vermin against so many rabbits. The balance of prey upon prey must be obtained, and we can keep this balance at its minimum by the use of the four diseases which assisted us to conquer the pest in South Wairarapa. Professor Aldis estimates that one dog can distribute 900,000 tapeworm-eggs in one day—ten dogs 9,000,000, twenty dogs 18,000,000. How totally different a remedy this! how far removed from the rabbit-netting remedy so strongly advocated just at present!

Referring for a moment to this rabbit-netting remedy, which, certainly, Professor Thomas takes no notice of, I am told that the leaders of the fencing movement in Canterbury and Hawke's Bay say that they expect to keep the rabbits entirely out of their provinces by its means. Let me tell the settlers there that every acre of their lands, sooner or later, must pass under the rabbits' feet. I advise them as strongly as I can to trust not to their fences.

Let me here explain fully my opposition to rabbit-fencing as a remedy against the rabbit-pest. As I have said above, directly I hear of a settler resorting to rabbit-netting I know at once that the rabbits will be preserved in his district; for rabbit-netting means his own sefish protection. For how can the netting be any remedy against the rabbits swarming upon the other side of the fence? Of course it is none. As a temporary stop it is useful, but it is no remedy. What the Royal Commission in Australia asked for was some remedy against the rabbit-pest. What the Royal Commission arrived at in their report was that rabbit-netting was the proper remedy. I immediately, in New Zealand, took up arms against that report, and have steadily tried to expose its fallacy; but the task is almost herculean. The most intelligent of my neighbours, to protect one year's grass, will resort to this rabbit-netting, and totally neglect the turning-out of the natural enemy or the spread of disease. Then he proceeds to poison, hunt, and trap, and reduce the rabbit-pest upon his own land, leaving it *worse than ever upon his neighbour's*, and utterly failing to reduce the future breeding-powers of his own rabbits (the natural enemies and disease alone doing that). Of course, the doe-rabbits that he catches and kills do not breed; but he puts nothing upon his run to check the future increase of those doe-rabbits which he does not catch and kill. In 1884, in my own mind, I condemned the use of rabbit-netting as far as my own run was concerned. I would

have nothing to do with it, preferring to turn out the natural enemy, and so assist in clearing my neighbours' lands, against which I had thought of erecting the fencing. Of course, I can say nothing if any settler chooses to adopt both the fencing and the turning-out of a sufficient number of the natural enemy and the spread of disease. All I should say then was that he did not rely upon his fencing as the remedy. I would also say that, were I living in a badly-infested rabbit district, with all the neighbours pulling against each other, in place of acting together and turning out the natural enemy and spreading these diseases, then in self-defence I might be compelled to erect rabbit-netting to save myself from ruin; but that would be no remedy against the rabbit-pest, which would flourish just as badly as ever on the other side of the fence. In South Wairarapa we never thought of this fencing at all, but took the wide measure of relieving the whole district at once by turning out ferrets, stoats, and weasels.

Strange to say, fencing was the only remedy recommended by the late Royal Commission in Australia. The Commission thought that bladder-worm might be useful, but fencing was chiefly relied upon. I have little experience of its use or effect in the dry central lands of the Australian Continent. All I know is that Nature never made use of this netting in reducing the rabbit-pest in the dry central desert-lands of Africa. She may have done so; but there is no record of these fences, or of the size of the mesh used. Practically, the Sydney Commission leaves the work of rabbit-extermination to drought in Central Australia. I should think that the dingo would be the best animal to cope with the rabbit difficulty in the uninhabited parts of the Australian Continent. That animal is well adapted to spread the bladder-worm disease, and it most certainly will do so. Professor Thomas thinks that the disease will be found more useful in New Zealand than in Australia, owing to the fact that the tapeworm-eggs must have moisture, dry winds and hot sunny days, in his opinion, being fatal to it. Here, again, from practical experience, I differ. The disease is worse with us in the dry, hot weather. In dry, hot Queensland there are occasional outbreaks of sheep-fluke—a very similar disease. In frozen Canada the bladder-worm thrives. There is a vitality of resistance, both against heat and cold, in these small forms of life which often surprises the zoologist, and I am rather astonished at Professor Thomas's statement. It is somewhat venturesome upon my part crossing swords with so able a man as Professor Thomas; but when he grasps the whole course of my argument, when he thinks of the money that is being wasted in wrong directions, then he will excuse me for writing so plainly as I am doing. Had he lived as long as I have

amongst the rabbits, had his fate depended upon their suppression, then he would have viewed the matter in a different light. But he was only ten days in our district; and, whilst I thank him sincerely for his able paper, still must I take exception to his deductions. I hope he will reply, through the Auckland Institute, to everything I say. The ball has only just opened in the matter of this rabbit difficulty. There will be scores of commissions, committees, and inquiries sitting upon it before a proper solution is arrived at. I can but tell how we succeeded in reducing the rabbits in my own district. I can but point to the similarity of the measures we adopted to the natural remedies happening in other parts of the world.

Professor Thomas points out the great difficulty of sending bladdery rabbits by sea. That is true enough. I tried to send a dozen shipments to Sydney: they nearly all died.

I am glad Professor Thomas says emphatically that bladder-worm does not affect sheep, but sheep-fluke may attack the rabbit. I must say that we have had no case as yet of a single sheep being attacked by bladder-worm—no sturdy or gid. We catch the bladdery rabbits all over the run, and there are usually 10,000 to 14,000 sheep running in the paddocks. There are also about 1,000 cattle, and 50 horses. (Seven out of ten rabbits we catch even now, as I write, are more or less afflicted with bladder-worm and liver-rot.) Neither have the horses or cattle suffered in the slightest way from these rabbit-diseases. A slight touch of sturdy did appear upon a neighbour's run (Mr. Bidwill's); but there were very few rabbits there at the time, and not a bladdery rabbit that I know of had been caught there. In Hawke's Bay Province, near Hastings, *where as yet no rabbits have been seen,* I saw in May last Mr. Ormond's sheepyards full of sturdied sheep. But this disease was accounted for by the excessive drought then raging, and the stock living upon tall fescue. There had been four years of drought there, and not much grass left, except tall fescue, the cattle living upon hay and willows cut down for them. I did not account for the sturdy in this way at all, but rather to the warm, dry weather then prevailing bringing to life the minute eggs from the sheep-sick lands—eggs of worms that had been deposited there year after year by the sheep themselves. Professor Thomas must kindly say how it happened that this disease only sprang into life in the driest and hottest season known there for years. But I must say that the sheep appeared to get worse after a small shower of rain.

Mr. Bidwill attributed his attack of sturdy to the ergot on the rye-grass. Again, if I remember rightly, this was in the hottest and driest month of the year. I rather think that it was

due neither to the tall fescue nor the rye-grass, but to the minute worms from the seed-eggs from the sheep-sick lands crawling up the long grass left, and so being eaten by the sheep. In both cases it happened upon ploughed ground, and in Mr. Bidwill's case on newly-ploughed land. This is only a supposition upon my part, which Professor Thomas can kindly consider.

The latest information I have received from a most trustworthy source is that the cattle near Hastings have also been attacked apparently by a foot-and-mouth disease, and that Mr. Ormond is now having the tall fescue grubbed up. I also faintly remember seeing a draught mare with the staggers in that district. I think it will be found that it is a worm (or worms) that is doing all this mischief, and not ergot. But it may be ergot. All I wish is to emphasize the fact that these diseases are attacking the stock near Hastings before any rabbits have been seen there.

With regard to bladdery rabbits being strong and healthy, I need only say that sheep fatten on fluke disease. Sheep-fluke runs a course of three or four months, and then, if the sheep affected is not killed, it rapidly dwindles away. We used to find scores of weak skeletons of rabbits upon the Dry River when the bladder-worm was bad, which could not run away from the dogs.

I should like to note the fact now, so that it may be afterwards referred to when the rabbit-pest has been reduced there, that the bladder-worm disease is among the rabbits over the whole of the North Wairarapa. I have heard of it personally from the owners of the following runs: Brancepeth (Mr. Beetham), Abbotsford (Mr. Whatman), Riversdale (Mr. Meredith), Matahiwi (Mr. Holmes), Bowlands (from Mr. McCrea, the manager). These runs are fairly wide apart, so that the disease is well distributed. In fact, it has a thorough hold upon the whole of the Wairarapa. Directly proper measures are taken to reduce the pest, similar to those we adopted in South Wairarapa, the disease will play its part, and keep the nuisance down to its minimum.

Professor Thomas says that the expense of distributing the remedy is not at all proportionate to the benefit to be derived from it. This, too, is quite a mistake. No expense to speak of is incurred in its distribution: therein lies its great beauty. Two shillings a year will provide any runholder with enough areca-nut to dose all his dogs, and so distribute the worm. These dogs must be used in the daily hunting. Feed them constantly upon raw rabbit, and they will get mangy and wormy. Each one of them, then, as Professor Thomas himself admits, will spread 900,000 eggs in a day. Wherein lies the expense?

Or, take rabbit scab or lice. It is quite easy to catch a couple of rabbits so afflicted. Shut them up with some healthy ones for a time after the poisoning, and then let them all go out upon the run. Wherein lies that expense?

Liver-rot I know little about. This disease was and is still upon the Dry River, and it was upon my neighbours' lands, especially Mr. Tully's.

To it as much as to the bladder-worm I ascribe our success in reducing the pest. I would point out that rabbit-fences check the free spread of these diseases, especially the fencing off the marshy damp spots from the dry uplands.

Professor Thomas's remarks upon Nature's method of check upon check are admirable. I have always revered Nature's wisdom in this respect. But the same checks appear to me to apply all over the globe to the same things. Thus the diseases or checks incidental to the rabbit apply just as well in Australia as in New Zealand, in North America as in Africa. Nature will give us no new check here, and the mistake we make is trying to seek for something new. Thus, if we wish to clear out any "bad spots" upon a run, the best plan is not to trap or fumigate, but to use tame ferrets and nets. My opinion is that natural enemies, as well as these diseases, will live just as well in Australia as in New Zealand. Stoats and weasels are perhaps more useful in the high snowy lands of the South Island of New Zealand than ferrets, the latter animal being the more delicate of the three. I am building little earth homes, and covering them with scrub, in various parts of my run, to afford warm shelter to the natural enemy. But all three animals will be found most useful in Australia, and the proper things to at once introduce there. Cats are useful everywhere.

In conclusion, I ask my hearers to excuse this long paper. In criticizing the work of so able a man as Professor Thomas I can only say that I do so from the practical-experience point of view. I know that practical experience is generally ignorant experience; but then, my measures having succeeded, my words should be listened to. I know also that it is difficult for one man to try and persuade a thousand, and the longer I live the more I doubt my own ability so to do. Each person holds a different opinion upon the rabbit question: I can only leave good Father Time to say which is right.

Sir James Hector has shown me the official correspondence on the occurrence of this disease in Canada, and permits me to append it as having an important bearing on the matter.

1st September, 1886.

Diseases for Rabbits.

MEMORANDUM by Sir JAMES HECTOR for the Hon. Sir JULIUS VOGEL, K.C.M.G.

THE suggestion of Mr. Stroever, to introduce the disease called red measle in the pig with the view of its destroying rabbits, would, as he himself admits, require very careful investigation before its adoption. I think there must be some mistake as to the nature of the disease alluded to. The pig is affected with two kinds of measles, one of which is a hydatid fluke which is the larval condition of the common tapeworm in man, and the other of the tapeworm of the dog. Both of these produce the measles in the pig, but I do not think they would be communicable to the rabbit.

Most probably, by the "red measle" is meant a very formidable disease known as the "swine plague," which is due to the presence of a minute organism known as *Bacilli suis*. This disease caused a loss in 1877 in the United States of £2,000,000. A Committee was appointed to investigate this disease, and, from their report, it can be communicated to several other animals, among which is the rabbit, and also the sheep. This was effected by artificial inoculation, but it does not appear that there is any evidence of its ever having spread naturally to either of these animals in the United States.

I think it would be well to ask the Agent-General to confer with some of the officers of the Canadian Government, now in London, with the view of ascertaining what is known as to the nature of a disease that periodically destroys the rabbits in the Canadian backwoods. In 1857–58 the Saskatchewan swarmed with rabbits, and Indians depended there on rabbits, largely, for their food in the winter-time; but during the winter of 1858–59 the rabbits almost entirely disappeared, and I found the Thickwood Indians starving to death in consequence. I was nearly starved myself with my party, travelling on the snow between Jasper House and Fort Edmonton, a distance of 230 miles. We had relied on finding rabbits plentiful for the whole distance, but only got one, and were several days without food. I was told by the hunters and officers of the Hudson Bay Company that about every seven to ten years the rabbits were attacked by a murrain that destroyed them. There was nothing unusual in the severity of the season on this occasion to account for their destruction.

My impression at the time was that the disease was a fluke or hydatid that attacked the liver, but soon spread to the muscles and other tissues of the rabbit. I have seen several instances of such a disease among the rabbits in the Waira-

rapa district; but it does not seem to spread—most probably owing to the absence of other carnivorous animals in which the hydatid exists in the tapeworm stage. The animals that prey on the rabbit in the country I speak of are the wolf, the kit-fox, and the common fox; so that if it is due to the fluke it is probable that it is from one of these animals that the disease is derived.

JAMES HECTOR.

Colonial Museum, 30th December, 1887.

The Hon. the Minister of Mines.

I HAVE already reported on these papers to the Joint Rabbit Committee.

The disease described by Mr. McBeath (p. 11) as so fatal to rabbits is the same that I referred to in evidence given on the subject in 1872. It is not a constitutional disease, as Mr. McBeath states, nor one affected by climate, as Mr. Bayley suggests, but is due to some form of an internal parasite (probably the *Cœnurus*) that gives rise to what are known among the warreners of Norfolk as "bladdery rabbits."

As I previously reported, in 1857–59 I have seen the rabbits wholly destroyed by disease over large districts of western Canada, and have in consequence been myself nearly starved along with the Indians, just as described by Mr. McBeath. There is reason to believe that this "bladder-worm" is one stage in the development of a kind of tapeworm that infests the lynx, fox, and perhaps other carnivorous animals that prey on rabbits. This double form of existence explains the periodicity of the murrain.

The chain of circumstances is somewhat as follows:—First period: Rabbits increase greatly until they are in swarms. Second period: Lynxes and foxes are attracted to, and thrive in, the district, and infect the rabbits. Third period: The rabbits die off, and the lynxes and foxes clear out to other districts in search of food. Fourth period: A few remaining rabbits commence to breed, and the first period recurs.

As the rabbit is much shorter-lived, more rapidly matured, and greatly more prolific than the fox or lynx, the latter can only be saved from destruction by migration. The fox and lynx do not therefore keep the rabbit in check merely by preying on them, but in a far greater degree by the conveyance of the disease that causes the murrain among the rabbits. In a somewhat similar manner the scab-insect of the cat is the same that infests the rabbit with fatal results—attention to which as a means of checking the rabbit-pest has been lately recalled by Professor Watson, of Adelaide; but it would be well to await the result of experiments that are being made to ascertain if this scab-insect is specifically distinct from that of the sheep.

The suggestion of Mr. Broden (p. 15) to introduce the fishers and the marten is hardly suitable to the conditions. Both these animals are only forms of the polecat that are specially adapted for living in dense subarctic forests. I am afraid that in New Zealand they would not live in our open country, but take to the bush, where there are no rabbits, as in America; for the American rabbit is really a hare that lives in forest country without making burrows.

It would be advisable to introduce the black-footed ferret which inhabits the prairies west of the Mississippi and lives on the gophers and prairie-dogs, which are rodents that have burrowing habits like our rabbits. Besides, the British martens have even a worse reputation than polecats as destroyers of lambs, one pair having been known to kill twenty-one lambs in a night.

The suggestion of Mr. Thaine, of Capetown, requires more definite information, founded on experience.

The civet-cat is not a cat, but a burrowing animal about 3½ft. long that inhabits subtropical Africa. As it is of great value on account of its musk-secretion, it would be a useful animal to introduce if it would thrive in this climate and live on rabbits.

The meer-cat is a small animal like a rat, being the African representative of the Indian mongoos, or ichneumon. It burrows in the dry arid plains of South Africa, and is very plentiful there. The Indian mongoos has already been turned out in New Zealand; but I have recommended the introduction of the kit-fox, a small species that lives in Oregon, and the Canadian lynx, as the most natural enemies of the rabbit.

JAMES HECTOR.

N.W. Mounted Police,
Battleford, 17th January, 1889.

To the Officer commanding C Division, N.W.M.P.

SIR,—In compliance with instructions received from you, I beg leave to report that last year and up to the present time there has been an unusual scarcity of rabbits in this part of the Saskatchewan district.

Every seven years the rabbits indigenous to this country become affected with a disease of the epizootic type, which, in my opinion, is malignant anthrax. The development of this disease may arise from contagion, mosquitoes and other insects with perforating apparatus to the mouth helping to communicate the disease; frequent inundations of banks of rivers; very warm, dry summers; extreme vicissitudes in temperature of either night or day.

During the summer of 1886 and the spring of 1887 an

immense number of rabbits died in this section of the country, many being found dead in the erect posture, which goes far to show that death must have been very sudden. In many cases diffused dropsical swellings were to be seen all over the body, the throat being much swollen, and a streaky bloody discharge oozing from the mouth. The *post-mortem* examination in most cases revealed the cellular tissues much congested with black tarry blood, the mucous membrane lining the trachea much congested, the liver enlarged and congested, likewise serous effusion into the thoracic viscera. There were also to be seen bloody exudations into all the internal organs.

I am, &c.,

J. L. Poett, Vet. Surgeon.

Extract of Letter from L. Clarke, Esq.

N. W. Territories, Regina.

In reply, I have to state that rabbits swarm throughout the country every seven years periodically.

For instance, in 1880 rabbits were found dead in scores under every bush; in 1881 but very few were snared; in 1882 they had almost totally disappeared; in 1883 the country was travelled for long distances without a rabbit-track appearing on the snow; in 1884 rabbit-tracks became common; in 1885 they became still more numerous; in 1886 they simply were swarming throughout the country; in the winter of 1887 they were still very numerous, but their numbers greatly diminished.

In 1885 lynx and foxes became numerous; in 1886 the same classes of fur-bearing animals were caught in great quantities; in 1887 the catch of these animals was very much larger than in the previous year. These two classes of fur-bearing animals prey entirely upon rabbits when the latter are plentiful, and destroy large numbers.

The rabbits, following the usual course of events, in 1888 will be attacked by a murrain or throat-disease, which will almost exterminate them.

I have an opinion that the rabbits, having eaten up all their natural food within their reach, are compelled to fall back upon other food-substance which proves the cause of the singular disease which kills them.

Scores of rabbits next year will be found under every bush, evidently choked to death, from the appearance of the neck and head.

I have, &c.,

L. Clarke, C.F.

EXTRACT of LETTER from A. McBEATH, Esq., *re* DIMINUTION of RABBITS.

Fort Qu'appelle, 25th June, 1887.

MY experience of this subject covers a period of nearly sixty years, during which time, as an officer of the Hudson Bay Company, I have had opportunities of observing the periodical increase and decrease of the rabbits over the whole of the North-west Territories, from the Rocky Mountains to Hudson Bay, and from the shores of the Arctic Ocean to Red River. Although I never made any special investigation into the subject of the rabbit-disease, still, in the ordinary course of my duties a certain amount of attention had of necessity to be given to the question of rabbits, as at some of the Hudson Bay posts where I was stationed they, in conjunction with fish, formed the principal (sometimes the only) food of the company's servants, besides being fed to the hauling-dogs. In some parts the Indians depended almost entirely on rabbits for their existence, and I myself have known many Indians dying from starvation during those years when the rabbits were practically extinct.

With regard to the exact period at which the disease appears among the rabbits, my experience goes to prove that regularly every seven years they reach the limit of their increase. The disease then, without any apparent cause, appears among them, and during the following three years they rapidly decrease, and again at the seventh year they are at their height.

As to the exact nature of the disease, I am unable to give any detailed information further than that every rabbit I ever found dead (and I have picked up thousands of them) showed the same symptoms of disease—viz., a lump like an enlarged gland on each side of the throat under the jaw-bones. In fact, it was from this sign that we decided as to whether they were fit for human food or only fit for the dogs. During all my experience I never heard of any other symptoms of disease being noticed. From the appearance of the dead rabbits I judged they must have suffered for a considerable time before they died, as they were hardly anything but skin and bone.

In my opinion, it is to this regularly-recurring disease that we must attribute the exemption of Canada from a rabbit-pest similar to that which has become such a serious evil in New Zealand. As a means of reducing the pest in New Zealand, I would respectfully suggest that a number of rabbits be exported from this country there, and, being turned loose among the native rabbits, would, in my opinion, by cross-breeding, introduce their disease, which I believe to be inherent in their blood.

A. McBEATH.

Extract of Letter from W. Brodie, Esq., President Toronto Natural History Society.

Of the several agencies which operate in Ontario and the North-west Provinces in limiting the increase of the native rabbit (*Lepus americanus*, Erxl.), the three principal are—(1) The cryptoid parasites, the development of which requires an intermediate carnivorous animal preying on the rabbit, such as the wolf, fisher, and owl. (2.) The wood-tick, a large external parasite, not yet well separated from other species of the genus, which, though often found on other rodents and on carnivorous animals, is especially a parasite on the rabbit. (3.) Carnivorous animals, the principal of which are the wolf, fox, lynx, fisher, marten, and owl. Of these, the fisher, marten, and owl prey more exclusively on rabbits than any of the others.

From remote and various causes these vary in number from year to year, and when a maximum of their number occur in the same season the rabbits are brought down to zero. The parasites reduce the staying-powers of the rabbit, thus making it an easier prey to its carnivorous enemies, while these, in turn, force it from the best feeding-grounds.

To check the increase of the English rabbit in New Zealand, I would recommend the importation and protection of the fisher (*Mustela pennantii*), the marten (*Mustela americana*), and the horned owl (*Bubo virginiana*). The first two are amongst the largest and most insatiable of their race, breed freely, are hardy, have a wide geographical range, are swift runners, have good scent, and freely follow rabbits into their burrows. They are also good climbers, thus easily eluding the pursuit of dogs and other large animals. Neither of them are large enough to do injury to any domestic animals except fowls. The horned owl is a large, hardy, and powerful bird, having a wide geographical range, lives to an old age, and breeds freely. Where rabbits are abundant it feeds almost exclusively upon them, and as it is a nocturnal feeder it is easy to protect domestic fowls from its attack. From the fact that these animals thrive well in confinement, eating living or dead food, and from their generally hardy nature, it is believed they would endure a long ocean-voyage.

W. Brodie.

Canadian Rabbit-disease.

Inspector Mackay informs me that there is an island in Lake Wanaka which at one time swarmed with rabbits, but they were attacked by a disease, and nearly, if not quite, exterminated. A similar instance exists in the Motunau Island, on

the coast about forty miles north of Christchurch, which was stocked with rabbits some thirty years ago by Mr. Caverhill. About every seven years disease nearly exterminates the rabbits; but the fittest survive and breed up again. The reason is popularly supposed to be that the rabbits increase beyond their food-supply, and, becoming weakened in consequence, are attacked by disease. This Canadian disease may be similar. R. FOSTER, Inspector,
Christchurch.

ART. XXXVI.—*The Soaring of the Hawk—A possible Reason for Notched Wing-feathers.*

By T. W. KIRK, F.R.M.S.

[*Read before the Wellington Philosophical Society, 31st July, 1889.*]

PLATE XVIII.

THE peculiar notched or cut-away shape of the primary feathers in the wings of many birds, more especially of the Raptores, or "birds of prey," has often attracted my attention, and the purpose of such emargination has been a source of curiosity to me for many years.

Before going further, however, allow me to direct your attention to this feather (Plate XVIII., fig. 1). You will observe that the outer portion of both the anterior and posterior vanes (I am speaking of the feather as though it were in position in the expanded wing) is cut away, the anterior for about half its length, the posterior for rather less. The form of these feathers has, of course, been frequently described, but I have never seen any explanation of why their shape should be as it is—indeed, I believe no such explanation has been published.

I recently stumbled, so to speak, upon what may perhaps prove to be a solution of the question. When up country a short time ago I saw a large hawk (*Circus gouldi*) shot while soaring. After receiving the charge it continued to soar although rapidly descending, and fell at some distance with both wings extended. On going to pick it up I was surprised to observe that, though quite dead, its wings were still expanded, and the primaries were locked by a partial reversal of their vanes, as shown in the specimen now on the table (fig. 2). Fig. 3 shows the under-side of the same wing.

The question arose, was this position of the feathers due to accident, or had the bird the power of placing them in this apparently unusual relationship? and, if the latter, with what object? After a careful examination, I replaced the vanes in

what, until more information is obtained, must be regarded as their correct position (fig. 4). Fig. 5 shows the under-side of the same wing. I then extended the wing, and after several experiments found that, by manipulating the joint with the fingers just before the wing became fully stretched, most of the primaries could be made to take the position they occupied when first examined—that is, the locked position (fig. 2).

This seems to prove that the bird had the power of, at will, altering the relative positions of these feathers. If such a supposition can be placed beyond doubt it will give a decided indication of the reason for their peculiar outline, and may perhaps throw much light upon the still-vexed problem of flight; for it would appear that this locking, together with the setting of the elbow-joint described by a celebrated naturalist, should be of considerable assistance to the bird in easing the strain which would otherwise be imposed upon the wing-muscles during soaring—a strain which various experiments have shown would be very great—indeed, almost insupportable—unless the muscles were relaxed at short intervals; but, as birds sometimes remain soaring for hours, it is evident that no such relaxation or flapping takes place. I am aware that the partial change in the position of the primaries would seem to lessen the resistance which the expanded wing could give to the air; also, that all soaring-birds do not possess notched feathers, and that some birds which do not soar have them.

I have not had the opportunity, nor do I possess the skill, requisite to minutely examine the internal structure of the wing, but feel sure that, although the anatomy of wings has received great attention, and is apparently well understood, it will yet be found that there is some muscle either set apart for the purpose of altering the position of these feathers in the manner indicated, or one the secondary function of which is to do so.

The whole question can only be decided by an extensive series of observations and experiments in the field, aided by the most careful anatomical work in the laboratory. This brief note is written, not with any pretence to settle the matter, but with the hope that others who possess more facilities for conducting experiments and research may be induced to study the subject. Then, perhaps, a satisfactory solution may be discovered.

ART. XXXVII.—*On the Wild Dogs of New Zealand.*

By TAYLOR WHITE.

[*Read before the Hawke's Bay Philosophical Institute, 12th August, 1889.*]

HAVING had the misfortune to become acquainted with wild dogs in the earlier days of settlement on new country, I will here give a description of nine.

I consider these dogs entirely distinct from the European dog. For the wild dogs met with on the Waimakariri River, in the alpine ranges of Canterbury, during the year 1856, were in colour and markings identical with those found in the alpine region of Lake Wakatipu, Otago, in 1860, a distance of several hundred miles apart. There seems little room to doubt that they were an original Maori dog. The fact of their wanting the two tan spots over the eyes mostly seen in European dogs of approximate colour is a very strong evidence also in favour of this opinion.

No. 1: White with patches of light gamboge-yellow, short hair, prick ears, longer hair on tail; dog; shot by self. No. 2: White, slight marks of black, slightly freckled with black short hair; dog; average size of a collie dog. No. 3: Dun or yellowish-brown, low-standing, hair long; slut. Nos. 2 and 3 lived together, and were poisoned. Only seen at a distance many times through a good telescope. I was told they were found dead near a nest under rock-shelter, in which were three dead pups. These dogs caused me a deal of work, I and my hutkeeper having to take turn-about in camping at night in the open on the further side of the sheep, the other sleeping in the tent. No. 1 was shot in the early morning, as he walked about quietly among the ewes and lambs which had not left camping-ground. He would walk after a lamb, when, the ewe turning to face him, the dog turned his head away, and was apparently interested in some distant object; on the ewe ceasing to notice him he would approach a little nearer, in a stealthy manner; so the flock were very little disturbed, only a few moving from before him. This was suddenly put a stop to by a bullet of lead from a tea-chest beaten up solid. The other two, working together, appeared to keep watch if the sheep were without protection in the day-time, when they picked the lambs, seizing them by the skin of the shoulder, which, if they escaped, would hang below the wound in a triangular flap, point downwards. One day I left the flock for a short time, and on my return they gave me a cheer, whether in the form of a howl or of a bark I cannot now define, before they disappeared over a hill-top, having visited the flock in my

short absence. But I have a strong impression that none of these dogs barked after the manner of the domesticated animal.

No. 4: White, freckled with black; dog. No. 5: White, freckled with black; slut. At the head-waters of the Oreti, Lake Wakatipu, Otago. These were a pair. Once my sheep-dog strayed away for a day or so, probably to visit them. He came home in a great hurry, and presently I heard a noise which reminded me of a noise from a kennel of hounds (which mostly consists of howling), when the two came in view running the scent. They saw me just as I was making for a hiding-place, gun in hand, so would not come very close up. I hit No. 5 in the neck with a charge of shot, my two sheep-dogs disappearing into the bush after the other. I made after her with my single-barrelled gun, empty, of course; but as we raced she began to recover, and distanced me after a long run.

No. 6: White, black spots, and freckled with black; dog. No. 7: White, light-gamboge colour in patches; slut. No. 8: White, light-gamboge colour patches; pup. These were a family party. I and my brother were riding home one very hot day when our dogs suddenly seemed to hear something which was inaudible to us, and started off at a great pace. We galloped after. On rising a terrace, there were the tame dogs holding the wild dog, the mother and pup standing near. On finding we only had a penknife, the dog was hamstrung, so that we might get the others also; but they had disappeared, and the heat was so great that our dogs would not take up the scent. So we returned, and killed the one caught.

No. 9: White, freckled with black; young dog. Ridden down and killed with stirrup-iron by John White, alone, without a dog.

These dogs, so peculiar in colour and markings, were of medium size, about that of an ordinary collie, neat head, sharp nose, without jowls or hanging lip; in shape like a Chinese hunting-dog. Those in Canterbury were seen in 1856, and several skulls were found, as if formerly plentiful, between the Poulter and Esk Rivers, branches of the Waimakariri.

In Otago during 1861 it is worthy of remark that those having large yellow patches were not freckled with yellow after the pattern of those marked with black and freckled with black. What I mean by "freckled" is a small collection of black hairs, here and there, on a white ground, wide apart, only sufficient to be visible, and not appearing as spots. No. 3 is remarkable as differing entirely from the others. Nos. 1, 7, 8, very handsome beautiful dogs.

Mr. Colenso holds the opinion that the Maori dog was a

small, helpless animal, only used as food or to catch ground-birds near at hand. One of his reasons is based on the fact that Captain Cook's party compare them in size to a shepherd's cur, which Mr. Colenso considers to be a cross-bred dog of small size, between a sheep-dog and terrier, or such small breed. Now, I feel sure that if you refer to Buffon you will find he speaks of the sheep-dog as a cur. In those days all dogs other than hunting or fighting dogs were designated curs; and so it became a term of reproach to speak of a person as a cur, meaning as without pluck or go. It did not indicate that the sheep-dog was of small size. Seeing the English sheep-dog was free from tax, but other dogs taxed, the shepherd would have no object in owning a sheep-dog other than true-bred. A dog of pure descent would be the most useful and trustworthy. From this it would seem Cook's voyagers really alluded to the genuine sheep-dog, which was a dog of considerable size, and active also.

Mr. Colenso quotes from the writings of George Foster, "A good many dogs were observed in their canoes, which they seemed very fond of, and kept tied with a string round their middle. They were of a rough, long-haired sort, with pricked ears, and much resembled the common shepherd's cur. They are of different colours, some spotted, some quite black, others perfectly white." The tying in canoe was, of course, to prevent them upsetting it. At Tolago Bay Cook says, "The dogs were very small and ugly."

Why should there not have been also toy-breeds? The Maori of the present day always keeps hunting-dogs, and also little deformed toys, which the women carry about in their arms when travelling, even long journeys on horseback. These small dogs are white, with long curly hair, and black nose.

Quoting from Mr. John White: "The canoe Mangarara (dry twig) brought reptiles, insects, also dogs of the mohorangi breed (untamed of Heaven)." This is a good name for a breed of dogs. "Now, Tamure had one of the ancient Maori dogs with him on this journey. Chanting the incantations over the dog, he sent him on before him. The dog passed over the path unharmed, and Tamure followed him."* Again, "Rua-putahanga said to herself, 'How shall I pass this place?' but her dog climbed up the cliff while she watched him, and she said to herself, 'Here is a place up this cliff where I may ascend.'" "The dog first discovered the road over Ta-piri-moko." These yarns would credit the dog with intelligence and activity. "Mahiti—mats made of the white hair of dogs' tails."

* White's "Ancient Maori History," vol. iv., p. 92.

Mr. Colenso quotes from Parkinson, "In one canoe a handsome man, clad in many garments, upper garment made of black-and-white dogskin." "An old man sat in the stern of the canoe; had on a garment of some black skin, with long hair, dark-brown and white border."

My dogs were all short-haired excepting the dun-coloured one, which will not match with the others. I cannot remember exactly about the tails, but, as I never kept one as a trophy, they most likely were nothing unusual. I have never seen dogs of these colours among either Maoris or Europeans, and am particular not to use the term "liver-coloured," as not describing the bright yellow on these dogs. I had a cover for my telescope made of the yellow-and-white skin, but lost both in a flood when driving sheep.

The food of these dogs was chiefly rats, of which there were great numbers, also the native quail and weka. From the droppings of feathers, I think that an occasional pigeon was caught, and also the ground-lark. The pigeon might be caught when feeding on the Maori cabbage. In those days, on Craigieburn there were acres of this cabbage growing thick in certain places, and the pigeons came long distances to feed on it. Maoris were never met with in these localities, and so I was ignorant on the subject of their dogs till within the last ten years or so.

I think I have given strong evidence in proof of these dogs being the indigenous dog of New Zealand. The fact of the hair from the dog's tail being especially valued by the Maori would point the inference that the body-hair was short in length. I append a newspaper-cutting referring to wild dogs which would seem similar in colour to No. 3:—

"The question as to whether there are in New Zealand aboriginal dogs—that is to say, dogs which are descendants of canines which were here anterior to the advent of the European — has often been discussed (says the *Rangitikei Advocate*), and the verdict has generally been in the negative. Mr. Bruce, M.H.R., Mr. William Cameron, and other Paraekaretu settlers, however, say that they have often seen dogs which are in the strict sense of the term 'native dogs.' These animals are of a perfectly distinct type. They are big and strong, and in appearance they exhibit a combination of the wolf and the fox. Their colour is fawn. A couple of these dogs have recently been visiting the Paraekaretu flocks of sheep, Mr. Bruce's amongst others. One of their characteristics is their fondness for lambs. They always go for the lambs first."

Art. XXXVIII.—*Note on the Fœtal Membranes of* Mustelus antarcticus.

By Professor T. J. Parker, F.R.S., University of Otago.
With an Analysis of the Pseudamniotic Fluid, by Professor A. Liversidge, F.R.S., University of Sydney.

[*Read before the Otago Institute, 11th June, 1889.*]

Plate XIX.

Several years ago I communicated to the Institute a paper on the gravid uterus of the common dog-fish, or smooth-hound (*Mustelus antarcticus*),* in which I showed that at the end of pregnancy each fœtus is contained in a separate compartment of the uterus, the chambers being separated from one another by complete partitions of mucous membrane, and each being lined by a thin transparent membrane, the *pseudamnion*, and tensely filled with a limpid fluid, the *pseudamniotic fluid*, in which the fœtus floats freely. I considered the pseudamnion to be a cuticular secretion of the mucous membrane.

Although I have dissected a large number of specimens since the time referred to, only one of these has thrown any light on the development of the membranes. It was caught about the middle of December, 1884: the examples containing ripe fœtuses were obtained in the spring (October).

When the oviducts were injected with alcohol from the cloacal end they became filled, showing that the partitions did not exist. On opening, each was found to contain seven eggs of a long-oval form, about 43mm. ($1\frac{2}{3}$in.) in long and 16mm. ($\frac{2}{3}$in.) in short diameter.

Each egg (Plate XIX., fig. 1) was surrounded by a distinct structureless membrane of a light yellow colour, adhering closely to the egg except along one meridian, where it passed off at a tangent to the surface, its two closely-applied layers forming a greatly folded sheet fully 30mm. (12in.) long when stretched out. The membrane is thus a closed sac, the sides of which are in contact except in the centre, where they are kept apart by the contained egg (fig. 2).

The membrane was found to adhere so closely to the uterine wall that the eggs retained their position when the uterus was suspended in a jar of spirit, instead of falling to the lower end, as would have been the case if they had been quite free; indeed, they did not fall out even when the uterus was opened.

It appears clear that this membrane is the pseudamnion

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* "Trans. N.Z. Inst.," vol. xv. (1882), p. 219.

before distension by fluid, and that it corresponds with the horny egg-shell of oviparous forms. The fact of its being formed before the partitions, to which in later stages it adheres so closely, is worthy of notice.

One very striking feature in the development of *Mustelus* is the extensive growth of the embryo (including the yolk-sac) taking place during intra-uterine life. As stated above, the impregnated egg is only about 43mm. long by 16mm. in diameter, while the ripe fœtuses are fully 220mm. (9in.) long, and 25mm. (1in.) across the head. As there is no vascular connection between parent and offspring, and as the latter is separated from the wall of the uterus by the pseudamniotic fluid, this fact is one of considerable interest.

In the paper already referred to it is stated, as the result of a rough analysis, that the pseudamniotic fluid contains a large proportion of urea, but little or no proteid matter. The following extract from a letter from my friend Professor Liversidge gives a more accurate account of the composition of the fluid. The sample sent to him was mixed with an equal volume of rectified alcohol.

"I have at last given your pseudamniotic fluid of *Mustelus antarcticus* a little attention. When you sent it last year I was afraid that it had been so long bottled (since the 10th October, 1883) as to be not worth examination; but as I got a crop of crystals almost at the first experiment I went on.

"There was a good deal of flocculent sediment, but the fluid above was fairly clear.

"1. To litmus the fluid was faintly alkaline.

"2. On slow evaporation it left crystals somewhat resembling urea, and a few isolated crystals of triple phosphate.

"3. It yields crystals with oxalic and nitric acid resembling the oxalate and nitrate of urea; but I do not attach much importance to crystals formed in complex organic fluids—*i.e.*, to their form.

"4. With fuming nitric acid, CO_2 (and probably N) is given off; did not test expressly for N gas: = urea.

"5. With $Hg2NO_3$ = white ppt. = urea.

"6. With $Hg2NO_3$ and excess of NaCl, no ppt. = urea.

"7. With Hg and HNO_3, from which coloured fumes were being evolved, the addition of some of the pseudamniotic fluid rendered the gases colourless; $\therefore$ CO_2 and N were evolved: = urea.

"8. Uric acid was found to be absent.

"9. Phosphoric acid abundant.

"10. Magnesia abundant, and probably present as triple phosphate.

"11. Lime present.

"12. On evaporation, 25cc. of the spirit-solution gave 1·135 grammes of extractive matter dried at 100° C., or 2·270 grammes for 25cc. of your original fluid. On incineration the mass swelled up and formed an enormous balloon of coke, but the carbon burnt off readily with a strong sodium flame, and left 0·248grm. of fixed salts, = 0·496grm. on original fluid.

"13. Tested for uric acid = no result.

"14. Tested for allantoïn = no result.

"Hence, taking all the reactions into account, this fluid seems to contain a very large percentage of urea; but a change may have taken place since it was collected."

DESCRIPTION OF PLATE XIX.

Fig. 1. Uterine egg of *Mustelus antarcticus* removed from the uterus, and with the surrounding pseudamniotic membrane spread out (natural size).

Fig. 2. Ideal transverse section of the same.

ART. XXXIX.—*On a Specimen of the Great Ribbon-fish* (Regalecus argenteus) *taken in Nelson Harbour.*

By R. I. KINGSLEY.

[*Read before the Nelson Philosophical Society, 5th November, 1889.*]

Plate XX.

THE fact that a capture of a specimen of the genus *Regalecus* is of very rare occurrence—no doubt partly owing to their inhabiting the deep parts of the ocean,—and the fact also that it cannot be studied, like many other fish, in its native element, create more or less interest in every specimen that may by chance be secured—an interest that affects even such of the general public who care nothing for genera or species, whose first anxiety is, perhaps, "Is it good for food?" To any one, however, who is the least inclined towards natural history or science there should be additional interest in the fact that (I think I am correct in so saying) there has not yet been a single perfect specimen captured; consequently all existing descriptions are either more or less compiled from imperfect or mutilated examples. It therefore becomes a duty to watch for opportunities such as the one I have made the subject of this paper, in order not only to add to our stock of knowledge fresh items of information, but to check and, if need be, correct the published descriptions.

I need not enlarge upon the speculations as to the cause of its rare occurrence; but with regard to the difficulties in securing a perfect specimen I should say they arise from two causes—first, and mainly, to the peculiarity of its structure and its extreme fragility; secondly, to the avidity with which sharks and other voracious fish appear to attack it.

With regard to the first, by reference to the drawing (Plate XX.) one sees at a glance that it would be impossible for a fish with such peculiar long slender ventral fins to escape damage in shallow water, even if they were not—as they are —very brittle in texture. The same remark applies in a less degree to the elegant crest of the dorsal fin. The body of the fish itself is extremely fragile—so much so that it usually breaks into two or more pieces whilst being hauled into a boat.

It may perhaps be interesting to some of those present if I mention a few facts about the genus before I proceed to describe the present example.

In vol. xvi. of the "Transactions," p. 284, there is an interesting article by Professor T. Jeffery Parker, B.Sc., on a specimen obtained at Moeraki, Otago. In it he states that Günther (the great authority on fishes) gives sixteen as the total number of captures in England from 1759 to 1878, or considerably over a hundred years. Of these, eleven are assigned to one species—*R. banksii.*

In New Zealand a specimen was obtained in Nelson in the year 1860, and described by Mr. W. T. L. Travers, but not at all clearly enough to identify the species. Another was caught at New Brighton, near Christchurch, in 1876, and described by Dr. von Haast, and made by him the type of a new species. A third at Little Waimangaroa, South Island: of this no exact description is recorded. A fourth is said to have been cast ashore at Moeraki in 1881; a fifth, the one most fully and carefully described by Professor Parker; also a sixth was stranded in Otago Harbour, 3rd June, 1887, of which Professor Parker, in vol. xx. of the "Transactions," gives a detailed and very full description.

The present example would thus appear to be the seventh recorded specimen captured in New Zealand.

All the species of *Regalecus* are distinguished by their great length in proportion to their height and thickness, most of them being from 8ft. to 18ft. long, 6in. to 15in. high, and not more than 2in. to 3in. thick.

The number of rays in the dorsal fin is very considerable, varying from 134 in *R. glesne* to 406 in *R. grillii.* Of these from 8 to 15 of the anterior rays are elongated into a beautiful crest. There are a variety of descriptions of this crest, facts and imagination appearing to be woven together. The most

peculiar is Travers's description: "From the back of the head rose several rigid circular spines about 18in. long, $\frac{3}{4}$in. in diameter at the base, tapering to a point, curving slightly backwards, hollow, and bristling along their whole surface with small spines directed upwards. These long spines appeared to be very brittle, as they broke off short when the fish struck the rock." He then goes on to say that the person who saw the fish run ashore described "these spines *as appearing like three small masts to a boat, through the whole length of the fish, disposed in pairs as follows: one pair just below the back and the other pairs immediately above.*" How he makes the first and last part agree, or what he wished us to understand by the latter part, I cannot comprehend.

The peculiar ventral fins are represented in all known species each by a single long ray terminating in a lobe, and in some cases with a posterior fringe of membrane, whilst the ray itself varies from 2ft. to 3ft. in length.

Günther and Yarrell state two species possess teeth, but all the remaining species are quite edentulous.

None of the species of *Regalecus* possess scales except upon the lateral line, but the skin in several species is studded with bony tubercles, in others raised into a kind of soft warts, all more or less arranged in three or four longitudinal bands.

In the fifteenth decade of the "Prodromus of the Zoology of Victoria," Professor McCoy gives a coloured sketch and also a description of a *Regalecus* caught between Australia and Tasmania.

I may here state that the name *Regalecus* is derived from *rex*=king, and *halec*=herring, in allusion to an old name given to this fish by the fishermen on the coast of Britain, who first saw it near that part of the ocean frequented by herring, and hence called it the king of the herrings.

I now proceed to the more direct subject of the paper. The specimen under review was caught on the 23rd September last by Astle—strangely enough, the same individual who captured the specimen described by Mr. Travers in 1860. I heard of it on the 24th, and as soon as possible I paid a visit to it. I found it, unfortunately, incomplete, a large portion of the posterior part being missing. Astle told me that he saw it swimming up the harbour, and, on nearing it, struck it several times with an oar, and eventually secured it with a noose on a rope; but in hauling it aboard the boat it broke in two parts, and also knocked itself about considerably in the bottom of the boat, damaging the ventral and dorsal fins. I made sundry measurements and took several notes in the hope that they might be interesting

to some of our members. I also made a sketch from which I have produced the one before you (Plate XX.). I was sorry to find, on my second visit, that the fishermen had cut it up, and thus prevented a photograph being taken.

From what I could see of it, it was very different in appearance from the sketch given of Sir Julius von Haast's *R. pacificus*, in vol. x., p. 248, and differed widely from his written description, but very nearly coincided with that given by Professor Parker in vol. xvi., p. 295.

The dark anterior stripes, however, shown by Von Haast were very similarly present, and, as shown on Plate XX., were elongate and irregular both in length and direction, and in no case posterior to the anus; the last elongated stripe occurring at almost exactly 36in. from the base of the ventral fin, and thus 21in. anterior to the anus. From this point posteriorly there were above the lateral line numerous more or less circular patches of moderately dark colour, while underneath the lateral line was a series of slightly elongated patches. This is worthy of note, since Professor Parker calls attention to this grouping of the patches in Professor McCoy's description, and calls them peculiar. Fortunately I had been very careful in taking particular note of the position of these markings.

The anterior portion of the lateral line in Von Haast's drawing is shown as gradually ascending long before it approaches the pectoral fins; but in my specimen it began to ascend much more acutely and very near to the pectoral fins, cutting off the longitudinal bands in its ascending course along the upper edge of the operculum.

I now give my measurements, and, assuming it to be of the same species as Professor Parker's, I speak of it as

Regalecus argenteus.

B., 6. D., $\frac{15\ (?)}{175\ +}$. P., 12.

Head—	
Length (jaws retracted)	7in.
" (jaws protruded)	9in.
Height, through the eye	8in.
Height of body, 2ft. from head	12·5in.
Length of body, as mutilated	9ft. 3in.
(I calculated about 3ft. to be missing: this would make the original length about 12ft., the height of the body at the fracture being fully 6in.)	
Diameter of eye	1·5in.
Distance from ventral fins to anus	4ft. 9in.

Dorsal rays—

1st, broken	part left $2\frac{7}{8}$in.
2nd, damaged	19in.
3rd, complete	21in.
4th, 5th } damaged	19in.
6th, 7th } broken.	
8th, complete	17in.
9th, complete	16in.

The remaining rays, 10th to 15th, inclusive, were broken and very much damaged. The remainder of the second dorsal fin contained 175 rays; and, as Professor Parker gives his number as 190, Von Haast 223, and McCoy 406, we may safely infer that the missing portion measured at least 3ft.

The 2nd, 3rd, 4th, and 5th rays were connected with a membrane for $7\frac{1}{2}$in. of their length. This would appear to coincide with Professor Parker's description of the first five rays being distinct from the remainder, and forming thus two portions, or "nuchal fins." I also noticed distinctly the spots upon the membrane of the first nuchal fin; they were, as stated by Professor Parker, very dark crimson. The 1st ray was stronger than any of the others, and a greater space existed between it and No. 2 than between any of the other rays. The 8th and 9th still retained their lobes in good condition.

The pectoral rays were, as stated, 12 in number, and $2\frac{1}{2}$in. long, width at base $1\frac{1}{2}$in., and nearly horizontal, as in Professor Parker's specimen, but far larger than those shown in McCoy's sketch.

The ventral rays were both missing, broken off at 5in., but I have since seen one of them. Its full length would be $30\frac{5}{8}$in., with a curve inwards at the extreme end, and with a delicate membrane along the posterior edge, and two triangular lobes at $8\frac{7}{8}$in. and $18\frac{1}{8}$in. from the base. The terminal lobe was oval, $2\frac{5}{8}$in. x $1\frac{1}{8}$in.; the whole in colour a deep bright red, the terminal lobe approaching to a dark crimson.

The branchiostegal rays and general features were so very similar to those so well described by Professor Parker that they need not be recapitulated.

There is, however, one other point to be noted. The specimen I found to be a *male*, whereas Professor Parker states (vol. xx., p. 21), "It is remarkable that all those previously captured, whose sex was ascertained, have been females."

It was surprising to me how few persons availed themselves of the opportunity of seeing it. A more strikingly handsome fish is seldom cast on our shores, and one would have supposed that its beauty, if not their curiosity, would have attracted more persons to view it.

I notice Professor McCoy makes a suggestion which appears to me very probable—namely, that this fish is the "sea-serpent" of newspaper accounts of observations made far out at sea by captains of ships, who, although perfectly trustworthy, may not be sufficiently instructed in zoology to enable them to give a good description of what they have seen. When we consider that one cast on the shore at Redcar in 1850 was 24ft. long, we may fairly suppose there are still larger ones in the depths of the ocean. Its great rarity renders it a most unfamiliar object to sea-faring men, and it does not require a very great stretch of imagination to see in a huge fish of this kind, with its peculiar and mysterious-looking crest elevated above the surface of the water, and its long body and undulating motion, an apparition which to ordinary people could be explained in no other way than by the supposition that it was the "veritable sea-serpent."

I was glad that I was not prevented by apathy—the Nelson epidemic—from viewing so interesting and elegant a denizen of the ocean-depths.

Art. XL.—*On the Occurrence of the Black Vine Weevil* (Otiorhynchus sulcatus) *in Nelson.*

By R. I. Kingsley.

[*Read before the Nelson Philosophical Society, 5th November, 1889.*]

I am not aware whether or no the *Otiorhynchus sulcatus* is common in New Zealand. I should not at all be surprised to find that it is far more common than is generally supposed, from the simple fact that the insect in its perfect form commits its ravages when the owners of the food-plants are, or ought to be, retiring for the night—*i.e.*, after 9 or 10 o'clock at night. In the daytime they are invisible unless the cracks and crannies of walls or the clods of earth are examined, when they will be found reposing with a very harmless and innocent aspect.

From the destructive nature of this species of insect—destructive in both its larva and imago states—it is most desirable to make the public aware of its presence in the colony, since it is said to be not indigenous, but one of the imported European pests.

On the 20th of last October Mr. Burford, who has recently commenced cultivating grapes, and has at considerable expense erected two glass houses, each some 80ft. long, called

to inform me that he had discovered upon his vines, at night, an insect new to him, which evidently was feeding upon the young shoots and leaves, and was present in immense numbers. From the specimen shown by Mr. Burford I at once recognised it as a weevil (*Otiorhynchus*), but was not certain as to its species. I therefore sent it on to Mr. Maskell, of Wellington, who very kindly obtained from Mr. Kirk its name, and also references to one or two books describing its habits, &c.

From Miss Ormerod's book, "Injurious Insects," page 305, I gather the following particulars of its habits and date of appearance (the latter I have changed to correspond with the difference of the seasons in New Zealand): "The eggs are deposited a little below the surface of the ground in the spring or early part of the summer. The maggot, or grub, is legless, whitish, somewhat hairy, and is to be found from about February to the following spring at the roots of its food-plants. The pupa is yellowish-white, and may be found about September, lying 3in. or 4in. below the surface, where it remains only about fourteen days before development. The weevil itself is of a dull-black colour, about ⅜in. long, with a short snout or proboscis; the body between the head and abdomen is granulated; and the elytra, or wing-cases, are rough with raised lines, and somewhat prettily marked with orange spots, which by means of a powerful magnifying-glass are seen to be composed of small tufts of golden down."

Some idea may be formed of the immense numbers infesting Mr. Burford's vines when I state that, although for the last fortnight he and his men have destroyed hundreds almost every night, yet when I visited the houses at 11 o'clock one night last week they were still to be found on nearly every young shoot.

It is impossible for these large numbers to be produced suddenly in one season, and I should say they have been in the garden for several seasons unnoticed, as they probably would have been this year had not Mr. Burford had special reasons for visiting his houses after dark, and thus detected the reason that his young shoots were looking so sickly and otherwise not thriving as they should have done. I exhibit specimens of the beetle obtained from Mr. Burford's vines, and for the benefit of those persons interested in vine-growing I subjoin some of the suggested remedies and preventives.

As the weevils only make their appearance by night, a commonly-adopted method is to spread white cloths below the branches, and to shake the beetles down at night, gathering them up and destroying them in hot water. It must be borne in mind that these beetles drop off on any disturbance or when a strong light shines upon them.

All crevices in the walls of houses should be stopped up, and clods of earth removed, and it might be advisable to run a line of ashes next the wall, sprinkled with a little kerosene, or a weak solution of carbolic acid in the proportion of one part acid to one hundred parts of water.

With regard to the larva, where attacks have been going on during the growing-season the roots should be thoroughly examined during the winter, and all maggots destroyed, and the roots dressed with lime, soot, or similar applications. The best remedy for a vine-border is to clear it away and replace with clean soil. Watering with a strong solution of ammoniacal liquor and common agricultural salt is effective in preventing the increase of this pest.

Art. XLI.—*Note on the Wandering Albatros* (Diomedea exulans).

By Sir Walter Buller, K.C.M.G., D.Sc., F.R.S.

[*Read before the Wellington Philosophical Society, 19th February, 1890.*]

Volume xxi. of our "Transactions," just received in London, contains a paper by Mr. A. Reischek on "The Habits and Home of the Wandering Albatros."

The author of that paper, having visited the Antipodes and Auckland Islands in the Government steamer "Stella" during the breeding-season of that species, seems to have enjoyed exceptional opportunities for studying its history in the adolescent state. But, unfortunately, through an obvious inaccuracy of observation, he has failed to give us any very definite information on the only point that presents any difficulty.

He says (*l.c.*, p. 128), "The albatros takes five years to become fully matured, and in each year there is a slight change of plumage. The young, which are hatched in February, are covered with snow-white down, *and a beautiful specimen in this stage exists in the Otago Museum.* In the following December they lose their down, and the plumage is of a brown colour, with white under the wings and on the throat. In the second year the plumage is the same, except that there is more white on the throat and abdomen. In the third year there is still more white, although mixed with blotches of brown. In the fourth year they very nearly acquire the full plumage. The male is white with a few very fine dark specks, except the wings, which are dark-brown. In the fifth year they reach their full growth, and the mature plumage is displayed—white with blackish-brown wings."

Mr. Reischek's account of the nestling agrees with Mr. Gould's, which is as follows: "The young are at first clothed in a pure-white down, *which gives place to the dark-brown colouring mentioned above*" ("Handb. B. of Aust.," ii., p. 433).

But the specimen in the Otago Museum to which Mr. Reischek refers is not, as his remarks would imply, a nestling covered with white down, but a well-grown fledgling, with tufts of white down still adhering to the plumage. This fledgling has not assumed "plumage of a dark-brown colour," but is of pearly whiteness. It is thus described in my second edition of "The Birds of New Zealand" (vol. ii., p. 192): "A fledgling, however, in the Otago Museum—obtained at Campbell Island—is entirely without the dark plumage. It has not yet completely lost the dense, fluffy, pure-white down which forms the clothing of the nestling. The head, neck, shoulders, rump, tail, and entire under-surface are of the purest white, having a fine silky gloss; the interscapular region is traversed longitudinally with club-shaped marks of greyish-black, increasing downwards, the larger feathers having their apical portion completely covered; upwards, towards the shoulders, these marks diminish till they become mere arrow-heads; on the mantle there are numerous marginal bars, but there is no vermiculation. The wings are brownish-black on their upper surface varied with white, all the coverts having white margins, and the quills are black. Bill yellowish-horn colour, with a bluish tinge on the upper mandible."

This is undoubtedly the "beautiful specimen" referred to by Mr. Reischek, because Professor Parker mentions in a letter to me that he had called his attention to it specially after his return from the Auckland Islands. Its condition is quite inconsistent with Mr. Reischek's account of a direct transition from the snow-white down into the dark plumage.

In my account of the species (*l.c.*) I have described another example, obtained at Waikanae, of small size, and evidently a young bird. This one had the whole of the plumage pure-white without any markings, excepting on the wings, which were black on their upper surface, largely dappled with white especially towards the humeral flexure. It is figured in my plate of the species, being the back figure standing on a rock.

The following was the only explanation I could offer (*l.c.*, p. 192): "We cannot suppose that the albatros is first pure-white, then dark-brown, and, after passing through several intermediate states, pure-white again in extreme old age. Nor would it be altogether safe, from the materials at present before us, to construct a new species. I am inclined rather to account for the differences I have mentioned on the supposition of the existence of dimorphic phases of plumage,

as in some other oceanic birds." This view may be the right one, or it may not; and it seems to me unfortunate that, with such excellent opportunities for studying the subject, Mr. Reischek did not place that matter beyond all doubt.

As to its requiring five years for the albatros to attain the mature white livery, this must of necessity be only conjecture. In my account of the bird I have described no less than ten phases of plumage in its progress towards maturity. That it takes a considerable time—probably several years—to develope the fully-adult plumage is perfectly clear, but it is manifestly impossible to fix the annual changes of plumage without having the birds constantly under observation.

Art. XLII.—*On the Assumed Hybridity between the Common Fowl and the Woodhen* (Ocydromus).

By James Murie, M.D., LL.D., F.L.S.

Communicated by Sir Walter Buller, K.C.M.G., F.R.S.

[*Read before the Wellington Philosophical Society, 19th February, 1890.*]

Plates XXI.–XXIV.

Since the publication of Darwin's classical works, "The Origin of Species," and "Variation of Animals and Plants under Domestication," the subject of hybridity, or hybridism, has been rendered highly attractive, and instructive to a remarkable degree. One sequel of his writings has been to foster the spirit of observation and inquiry regarding individual bodily variations or peculiarities of habit, however slight or merely of passing occurrence they might seem to be at first sight.

The special interest attached to the supposed hybrid about to be reported on is one of negation rather than support. But a register of the data nevertheless shows certain side-lights, which may be of use hereafter when similar inquiries as to mixed parentage are undertaken.

Before proceeding to inquire into the evidence to be derived from the anatomy of the attributed cross-bred fowl more immediately the subject of this paper, I shall shadow forth in a cursory manner what hitherto has been asserted in support of the interbreeding of the weka and the fowl. In the first edition of "The Birds of New Zealand," 1872, p. 165, the author, in referring to the North Island woodhen (*Ocydromus earli*), drew attention to a reputed hybrid with the fowl seen

by him at Waikanae, and to another in the possession of Dr. Hewson, at Otaki; also that Dr. Hildebrand, of Wairarapa, conceived he had several in a clutch from one hen. This hybridism was disputed by Capt. F. W. Hutton, of New Zealand ("Ibis," 1874, p. 39), and certain English ornithologists. Later on Sir W. Buller ("Trans. N.Z. Inst.," ix., p. 341, 1876) supplemented his remarks by the further observations of Capt. Mair, of Tauranga, on his own account, and who likewise adduced native testimony of the not-infrequent occurrence of the interbreeding of the weka and fowl; and, lastly, by a note from Mr. T. E. Young, of the Native Department, supporting the hybrid theory.

A belief in the said hybridism having thus been extensively promulgated by independent witnesses, it is more difficult to eradicate than to prevent the spread of the current notion, except by a comprehensive specification of structural data substantiating a contrary opinion. This is the wherefore of the length of the present communication.

Unfortunately for those persuaded of the intermixture of race, direct proof of the illegitimate union of *Gallus* and *Ocydromus* is wanting. Their evidence is mainly derived from predominating resemblances in the offspring to the rail—such as colour, wing-feather banding or pencilling, hairy feathering, feeble development of wings and tail, form of head, body, and legs, the peculiar furtive, prying, rail-like gait and nocturnal habits, with the fact of the weka's freely associating with the fowls in the Maori clearings.

With respect to the special bird anatomized, it was obtained by Dr. Lewis, the Medical Superintendent, Rotorua, and sent to England as a typical example of the hybridity in question. Its history and habits agreed as above indicated. I may here incidentally refer to my artist Mr. Berjeau's drawing of the bird, given in Plate XXI., fig. 1, which it is to be remembered is not taken from actual life, but may be looked on as portraying in a general way the descriptions given by the several authorities above specified who have seen the pseudo-hybrids running about the native villages. The plumose feathering is from the dried skin after spirit preservation, the head likewise. The comb is represented lapping towards the observer; whether it was carried more erect during life I cannot say. Captain Mair (*l.c.*) avers the females seen by him were combless.

I received from Sir Walter Buller a square tin canister, soldered down and air-tight, containing the bird preserved in strong spirit. I found the specimen in good condition for anatomical examination, though not perfect in plumage. The plumes of the primary and secondary wing-feathers and those of the tail-feathers (retrices) had been broken away, but

leaving sufficient of the quills intact to enable their numbers to be counted.

The bird was an adult of stout build, muscular, though in very lean condition. It outwardly resembled an ordinary cock of good size, inasmuch as there was a fair development of comb and wattles; nevertheless, partly from its unusual plumage, and otherwise, there was something, not easily defined, suggestive of its being a fowl of impure breed.

As taken out of the preservative fluid, before drying, the ear-coverts were of a dark brownish-black, browny-black, or sooty-brown, as, indeed, were such feathers of the body and of the tail as were left; the tint varying in different degrees of intensity. When dried, however, the feathers assumed quite a bluish-grey hue, and were remarkably fluffy.

The bill was proportionally strong, with terminally deflected mandible, as in the common fowl. The legs likewise were proportionally strong, and scaled; a stout, short spur existing on both limbs, on the usual situation. The tarsometatarsal scutes and scales agreed rather with the form and disposition extant in *Gallus* than in *Ocydromus* or *Rallus*: this inasmuch as there was a double row of large, somewhat hexagonal-shaped scales dovetailing in front, and gradually wending outwards distally, so that at the phalangeal end the inner row became medial, and thence singly clothed the long middle anterior toe. Traces only of a feathered leg were apparent in this specimen examined by me.

The rails are distinguished by a more regular delicate scutellation, only a single uniform row of sharply-bordered transverse scales clothing the tarso-metatarse, and the toes are covered with a similar diminutive pattern. There is no leg-spur, and the feet altogether, though long and relatively large for the bird, are much more slender than in the quasi-hybrid under examination.

Some rough measurements of head and limbs:—

	Inches.
Occiput to tip of the bill	3·0
Mouth-angle to tip of the bill	1·4
Fore angle of nostril to tip of the bill	0·8
Length, tarsus to tip of mid-toe, including nail ..	8·3
„ of anterior middle toe, including nail ..	3·3
„ „ outer toe, including nail ..	2·1
„ „ inner toe, including nail ..	1·8
„ of hind toe (hallux), including nail ..	1·3

The spur is 0·4in. long, and the same breadth at the base. The relative proportional length of the bill to the head is as 1 to 3 in this bird and the fowl; in *Ocydromus* it is as 1 to 1, or even longer.

The feathering throughout (notwithstanding its soft, fluffy peculiarity) had a gallinaceous facies, distinctly manifested by

the presence of sparse wiry neck- and loin-hackles, by sixteen strong quilled tail-feathers, and twenty-six wing-feathers, the eleventh being relatively slender. The feather-tracts corresponded to those of *Gallus*, as given by Nitzsch,* the contour-feathering possessing very downy barbules. Twelve weak short tail-feathers and twenty-two wing-feathers are the usual complement in the *Rallidæ*, and their contour-feathers possess more filiform and less downy barbules.

With regard to the viscera, the presence of a large and capacious crop is of significance, inasmuch as this is a true galline feature; such œsophagal inflation being characteristically absent in the *Rallidæ*.

A proventriculus, a stout muscular gizzard, a pair of long capacious cœca, and the general structure of the intestinal tract, bore resemblances to those extant in the genus *Gallus*, the viscera of a fresh fowl having been compared with them side by side. But, as these characters are shared by the rails, it is difficult to define precise comparative differences where the sizes of the birds are unequal—unless it may be that in the supposed hybrid a wider terminal sacculation of the cœca be instanced.

The contents of the crop and gizzard consisted chiefly of a considerable-sized mass of matted vegetable matter, along with grumous material of a semi-digested nature, and particles of gravel. A closer examination showed that the bulk of the vegetable substance was made up of fibres of grasses, some with minutely-serrated margin. Intermingled among the contorted and woven-together grass-fibre were remnants of small leaves, several distinctly hirsute. There was no grain whatever, and of seeds I only recognised one or two—black, smooth, shiny ones, less than a split-pea in size. Some other irregularly-shaped soft particles arrested my attention, and proved to be partly-digested cartilage or gristly stuff. Of other animal material I detected an insect, in the presence of a tiny portion of the elytra of a lustrous beetle. There was a scarcity of sand among the gravel. The latter was made up of irregular fragments of rock, well rubbed—viz., of pure quartz, quartzite rock, fine-grained grey granite, and agglutinated sand-grains or scoriæ, each more or less easily recognisable.

The nature of the food thus showed that the bird was a ravenous feeder, and not an inmate of a farm-yard. Seeds, pulpy fruits, or other garbage not being to hand, it doubtless gladly availed itself of coarser, less nutritious fare. Thus, probably, may the lean condition of the body, already mentioned, be accounted for.

Of the mouth-parts, the contour and sculpture of the

* "Pterylography," Engl. Transl., Ray Soc., p. 115.

palatal surface, and similarly the tongue, faucial area, laryngeal cleft, and larynx generally, were for practical purposes identical with that of the hen compared. On the contrary, in *Ocydromus*, as in other rails, the slender, lengthened, and laterally-compressed probing tongue and naso-maxillary region gives correspondingly a different facies to these parts, therefore quite unlike the short, flat, triangular tongue-parts of the fowl tribe.

The hyoid bones also agreed with those of the fowl. Not only was this the case in the difference of their relative strength to those of rails, but in the short, broad tongue-cartilage, the stout and broad glossohyal, with its pronouncedly-forked ceratohyals, and in the proportionally strong, high-ridged anterior basi-branchial bar.

In *Ocydromus* the deficiency of bony hyals, rudimentary ceratohyals, and narrow, very elongated cartilage of the tongue, are quite distinctive from those of the preceding.

As to the presence of double carotid arteries in the specimen, these obtaining both in the rails and fowls,* no inference can be drawn therefrom.

My dissection of the muscles confirmed gallinaceous structure from the myological standpoint; but this rather in the general configuration of parts than in variations of individual muscles from those of the *Rallidæ*. As a matter of fact, there are no salient distinctions therein between the two groups. This has been partly shown by the late Professor Garrod in his two papers,† "On certain Muscles of the Thigh of Birds, and on their Value in Classification."

I may note that in the reputed hybrid in question an ambiens was present in both limbs, that on the left side (agreeing with Garrod's description of that muscle, P.Z.S., 1873, p. 629) being inserted in, or, rather, fusing with, the topmost fibres of the flexor digitorum, whereas on the opposite right limb the tendon was lost on the fibrous tissue abreast of the knee-cap, and it did not cross to the outside of the joint.

On the right side a distinct femoro-caudal was not appreciable. On the left side it was represented by a very weak fleshy ribbon, which, as it ran towards the femur, blended in an undefined pencil of fibres with the insertion of the accessory femoro-caudal. The latter muscle, though thin, was a fairly-well-developed sheet on both sides. The pectorales

* Garrod, "On the Carotid Arteries of Birds," P.Z.S., 1873, pp. 468, 469.

† P.Z.S., 1873, p. 626; and P.Z.S., 1874, p. 112. These contributions are based, but with great extensions, on Sundeval's original observations, 1843, afterwards worked into his article, "Om muskelbyggnaden i foglarnas extremiter," Nat.-forsk. Sällsk. forhandl., 1851. Garrod adopts Sundeval's nomenclature, which I here follow for convenience' sake.

muscles, conforming to the deep-keeled sternum, were ample, the second pectoral reaching quite to the end of the sternum, and a third pectoralis was present.

Professor Garrod has recorded (*l.c.*) the occasional absence of a femoro-caudal muscle in certain galline birds, so that its being wanting in our bird hardly merits more than passing remark.

The skeleton emphasized the preponderance of fowl-attributes. The skull, in its breadth to depth, naso-maxillary shortening, general robustness of fronto-cranial section, and contour as a whole, could not be mistaken for that of any of the rail tribe.

The more salient points, agreeing generally with that of a Dorking fowl's cranium, used for comparison, are as follows: Broad wedge-shaped naso-maxillary region, with deflected tip; high ovoid narial vacuity; broad quadriform frontals overarching orbits; a bony interorbital plate; spoon-shaped upper limb of lachrymal; palatal surface continuing wide forwards; broad maxillo-palatines; vertical post-palatine plates; stout basi-pterygoid; very broad basi-occipital, and very large carotid foramina. As distinctive of breed, and in this respect resembling that of the Cochin fowl, I may add a high arched occipital foramen, and a marked depression at the junction of the frontals and naso-maxillæ.

Ocydromus cranially is distinguished by—Narrow lengthened naso-maxillary region; like-shaped narial vacuity; frontals also long and narrow, only slightly overarching the orbits; a large open interorbital space; attenuate upper limb of lachrymal; palatal surface remarkably narrowed forwards; narrow, compressed, oat-shaped maxillo-palatines; horizontal furrowed post-palatine plates; slender, elongate basi-pterygoid; narrow, prominent basi-occipital, and small carotid foramina.

The broad, arched mandible contrasts with the much longer, narrower, straighter, and deeper lower mandible of *Ocydromus*.

The sternum of the assumed hybrid is quite double the size of that of *Ocydromus*, and it comports with the gallinaceous type. The body is very narrow and spatular, the keel immensely deep anteriorly, before which is a broad scooped area, and terminal rostrum; there are also present a pair of very great lateral notches, and exterior broad bony processes on each side.

The pectoral arch denotes fowl, the furcular appendage being ample, and shaped somewhat as in the Dorking breed.

The shallow-keeled, relatively broader-bodied, narrow, single-notched, and extremely weak sternum of *Ocydromus* could not be confounded with the preceding; still less the

slender, simple, widely-arched furcula. Whilst, as Professor Huxley* has shown, it is a special characteristic of this ralline genus for the coracoid and scapula to meet at an obtuse angle.

Almost unfitted for sustained flight, the wing-bones of *Ocydromus* are feeble in the extreme as compared with those of the bird in question. The two could not for a moment be mistaken for one another in size, relative stoutness, configuration, bony prominences, and muscular impressions.

The large pelvis in all its aspects agrees with that of the fowl race. Very broad fore-iliac plates are continued backwards towards the acetabulum. The post-iliac or rump region is still wider, full, flattish, or smoothly convex, the interior being uniformly capacious. The remarkably deep ischia project beyond the outer border of the post-ilia. The pubic rods reach ½in. behind the V-outlined ischia. The ischiatic foramina are large and antero-posteriorly oval. There is a prominent cotyloid or prepubic process. The Ocydromine pelvis, on the contrary, is distinguished by its uncommon narrowness and restricted capacity, being bottle-shaped, or with unusually deflexed and laterally-compressed fore- and mid-ilia. The rump-region is equally narrow, prominently and obliquely ridged atop, and square-set behind: this by reason of an overeaving of post-ilia over the small, straight-set, impressed, vertical, and terminally-truncate ischia, which the straight pubic bars barely pass. Prepubic processes minute; sciatic foramina small and roundish.

The specialized hind limbs of *Ocydromus*, so out of proportion to its diminutive wing, would suggest some trace of such difference in the bird supposed crossed from it. Such, indeed, was not the case. The moot bird had, it is true, big leg-bones, but these were quite in keeping with the dimensions of its wing-elements, and not exaggerated relatively to the latter, as is the ralline peculiarity. The leg- and toe-bones strictly agreed with those of the fowl in every particular, bony processes and ridges being very pronounced, and general stoutness considerable, as opposed to *Ocydromus*. In the femur the trochanteric eminence, superficially and otherwise, was great, the external condyle lower than the internal. The tibial cnemial process was towards the median line and lengthened, the inner distal tibial knuckle the largest; the fibula reached to the end of the shaft of the tibia. The bone of the upper post-tarsal projection was short and perforated. Hind-toe bones as long as the first phalanx of the mid-toe;

* "Classification of Birds," P.Z.S., 1867, p. 425; and "Anatomy of Vertebrated Animals," 1871, p. 289. An observation first made by Professor Newton (see "Birds of New Zealand," 2nd ed., vol. ii., p. 108, footnote).

inner toe slightly longer than outer toe; mid-toe about one-third longer than either; claw-bones relatively wide.

Of the leg-bones in *Ocydromus* the following obtains: The trochanter is depressed; the external condyle barely descends beyond the internal one; the cnemial process towards the inside of the bone is short, but relatively and absolutely more prominent than in the larger pseudo-hybrid skeleton; the outer tibial knuckle is the largest one; fibula two-thirds the length of shaft of tibia; the upper post-tarsal projection only extends down one-fourth the length of the tarso-metatarse, is furrowed, but has no foramen. Hind-toe bones shorter than the first phalanx of mid-toe; outer and inner toe subequal in length; mid-toe one-fourth longer than either adjoining; claw-bones laterally compressed.

With regard to the vertebral column, costæ, and cavity of the chest in this quasi-hybrid, these in the main coincided with what Darwin records of the fowl in the volume already quoted. Thus, we reckon as present 14 cervical,* 7 dorsal with ribs, 15 lumbo-sacral, more or less ankylosed, and, lastly, 6 or 7 caudal vertebral elements. It is worthy of notice that the 6th cervical presented the bridge of bone said by Darwin to exist in the Cochin fowl. The 14th cervical did not bear ribs. The ribs extant were 7 in number and proportionally strong and broad.

In the skeleton of *Ocydromus* used for comparison the cervicals were 14, dorsals 8 freely-separated vertebræ, 14 more or less coalesced lumbo-sacral, and 11 caudal vertebral bodies, all free and movable on each other. The entire spinal column and its related parts show a delicacy of mould, and this is very notable in the tail-elements, which organ, be it remarked, has in the rail tribe only short soft feathers clothing it. There are ten ribs, seven of which are very long, and all are attenuate bony rods; six have mid-costal processes. The last cervical and first ilio-sacral vertebra have each a pair of short free ribs. The chest cavity is unusually deep and narrow, as contradistinguished from that of the doubtful hybrid or that of the common fowl.

From the foregoing data it will readily be conceded that in all the exterior as well as interior organization of the bird under examination scant ground is left for support of its being a hybrid between the fowl and weka rail. Assuming no detailed anatomical investigation had been undertaken, the

* Darwin, in a footnote, *loc. cit.*, p. 266, accuses himself of not correctly assigning the vertebral group-numbers, referring to Prof. W. K. Parker's opinion thereon. I prefer to follow his own notation and statements, as more readily allowing comparisons, while not involving any theoretical question as to what constitutes vertebral regions in birds—a subject, moreover, by no means yet settled among osteologists.

impression nevertheless might remain with those who saw the creature alive, and were acquainted with its currently-reported history, that its habits—so opposed to those of the ordinary fowl of the farmyard—could only have been those of a hybrid bird. It behoves, then, to account for these assumed peculiarities of manner; and in the fact that the bird had adopted feral instincts and habits a clue is given to read the case aright.

Darwin,* after referring to Wallace's † views, says: "Nevertheless I do not doubt that the simple fact of animals and plants becoming feral does cause some tendency to reversion to the primitive state; though this tendency has been much exaggerated by some authors." He also admits‡ "that with crossed animals a similar tendency to the recovery of lost characters holds good even with instincts."

That a healthy and robust chicken, reared under primitive conditions and in the proximity of a forest or waste lands, should forsake its more domesticated companions, and prefer to lead a free and roving life, accords with the above savant's teachings. It needs no stretch of the imagination, then, to conceive how the reputed semi-nocturnal rail-like habit is associated with no other than a return to that of the wild stock. The occasional visit to the poultry-yard towards nightfall may have been partly in search of food, but, doubtless, also due to sexual manifestations, for a knowledge of the presence of its kindred in the neighbourhood would be an intuition easily acquired. Much of the averred shyness and timidity may be attributed to the bird's forest seclusion and fear of man. Its skulking, stealthy gait (so characteristic of the wekas and alien *Rallidæ*) when in quest of food denoted that ever-watchful care for its safety inherent and necessary to wild birds continually on the alert for hidden enemies.

The diminutive drooping tail, much relied on as a ralline feature, is at best weak evidence of hybridity, nor specially favours reversion to feral habit. It, like the plumose, hairy, or flocculent feathering thought to be so extraordinary by the New Zealand observers, rather represents what is characteristic of certain breeds of fowl; while the grass-eating proclivity (witness Cochin-fowl habit) may not only be referred to breed, but with greater probability forced upon the bird by scarcity of graniferous diet. That this reputed hybrid, but nevertheless undoubted fowl, was of mixed derivative origin is denoted by its external characters superadded to by points in its osteological construction.

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* "Animals and Plants under Domestication," vol. ii., p. 32.
† "Jour. Proc. Linn. Soc." (1858), iii., p. 60.
‡ *Loc. cit.*, ii., p. 43.

If we take Tegetmeier,* a reliable authority on fowls, or Darwin's† synopsis of breeds and sub-breeds, in his chapter on fowls, it is easily seen that the great majority of the breeds must be discarded as completely at variance with the bird under consideration. A few breeds only are worthy of notice. Though the Malay has sixteen retrices, and small downward sloping tail, yet in all other characters it widely diverges. The Cochin, in its soft downy plumage, short sixteen-feathered tail, dumpy spurs, medially-furrowed and depressed frontal bone, high-outlined occipital foramen, bony bridge on the sixth cervical vertebra, feathered leg (though superabundant), long middle-toe, and grazing propensity, much better agrees with the condition of things in the supposititious hybrid, more particularly one variety of Cochins presently to be mentioned. The pure Dorking, again, in its wide interorbital region, and partially in the outline of its furcular termination (hypocleidium), harmonizes; but, on the other hand, its additional-toe character and other features do not coincide. Further, the breed of so-called Silk Fowls, in the very characteristic nature of their plumage and other attributes, have much in their favour, but I did not observe in the alleged hybrid that distinguishing peculiarity of the Silk Fowl—namely, the black skin and black periosteum of the bones. Referring to the Silky Cochins, Tegetmeier's words are so explanatory and appropriate to the present case that I quote accordingly:—

"The singular variety known as Silky Cochins, or sometimes as Emu Fowls, is simply an accidental variation of plumage which occasionally occurs, and which may be perpetuated by careful breeding. The cause of the coarse fluffy appearance of these remarkable fowls is to be discovered in the fact that the barbs of the feathers, instead of being held together by a series of hooked barbules (so as to constitute a plane surface, as occurs in all ordinary feathers), are perfectly distinct; and this occasions the loose, fibrous, silky appearance from which the fowl obtains its name. Silk Cochins are usually inferior in size to the ordinary varieties."‡

In short, one thing with another, it appears to me that this occasional production of aberrant, curt-tailed, hairy-plumaged chickens among the New Zealand poultry points to a strain of Cochin or Silky Fowl blood which now and again crops up. Where the bird has from circumstances run wild there is a tendency to feral habit and pronounced traits of wild breed, those induced by domestication—as size, &c.—diminishing in a corresponding ratio.

* "The Poultry Book;" by W. B. Tegetmeier; Lond., 1867. And "Encycl. Brit.," ed. 9, vol. xix., p. 644, art. "Poultry."

† "Animals and Plants under Domestication," i., p. 226.

‡ "The Poultry Book," by W. B. Tegetmeier, p. 46.

In conclusion, I may add that Mr. Beddard, Prosector to the Zoological Society (through Sir W. Buller's courtesy), examined a female supposed hybrid, satisfying himself of its being a true fowl; his (and my old) colleague, Mr. A. D. Bartlett, the Superintendent of the Gardens, from casual inspection of its outward aspect, inclining to regard it as a hen of the Silky Fowl breed. Thus, independently, we three observers have arrived at a nearly similar view respecting a male and female of the supposed hybrid fowl and weka rail; and, from the anatomical evidence instituted, the question, I should say, may be regarded as finally settled.

DESCRIPTION OF THE PLATES.

Plate XXI.

Fig. 1. Sketch of the supposititious hybrid between the domestic fowl and the weka rail (*Ocydromus greyi*, Buller). The attitude here given and the general aspect of the plumage are ideally drawn according to the description of the bird's carriage, as given by Sir Walter Buller and his correspondents.
Fig. 2. Part of its right lower leg and hind-toe, showing the spur and the scaly covering. Natural size.
Fig. 3. A back view of the skull, natural size, of the same bird, to illustrate the vertically high-shaped occipital foramen. (Compare Darwin's figure of that of the Cochin cock, "Animals and Plants under Domestication," vol. i., p. 261.)
Fig. 4. A side view of the same skull. Also natural size.
Fig. 5. A corresponding side view of the skull of the southern weka rail (*Ocydromus australis*). Natural size.

Plate XXII.

Figs. 1 and 2. Upper and lower surface of the skull of the supposed hybrid fowl. Natural size.
Figs. 3 and 4. Similar views of the cranium of *Ocydromus australis*, for comparison with the preceding figures. Also natural size.
Fig. 5. Reduced drawing of the exterior of portion of the digestive organs of the suggested hybrid: *œ*, œsophagus; *c*, crop; *p*, proventriculus; *g*, gizzard; *i*, intestine.

Plate XXIII.

Fig. 1. Tail-vertebræ of the supposed hybrid in side view. Natural size.
Fig. 2. The same parts in *Ocydromus australis*. Also natural size.
Fig. 3. Outside view of the lower mandible of the assumed hybrid. Natural size.
Fig. 4. Similar aspect of the lower mandible of *O. australis*. Natural size.
Fig. 5. Upper view of the lower mandible of the supposed hybrid. Natural size.
Fig. 6. Corresponding bone of *Ocydromus*. Also of natural size.
Fig. 7. Upper surface of the tongue-bones and cartilaginous appendages of the *quasi*-hybrid. Natural size.
Fig. 8. Same parts in *O. australis*. Natural size.
Fig. 9. Right tarso-metatarse and foot of supposed hybrid fowl, in front view, showing scutellation, &c. Half natural size.
Fig. 10. Corresponding parts in *O. australis*. Natural size.
Fig. 11. Anterior view of the tibial cnemial process and upper end of right tibia of the so-called hybrid.
Fig. 12. The corresponding bone in *O. australis*.

PLATE XXIV.

Figs. 1 and 2. Top and side view of the pelvis of the supposed hybrid fowl. Half natural size.

Figs. 3 and 4. Corresponding views of the pelvis of *Ocydromus australis.* Only reduced two-thirds natural size.

Fig. 5. The sternum of the supposed hybrid seen from below. Of half natural size.

Fig. 6. Similar view of the sternum of *O. australis*, but of natural size.

Fig. 7. Side view of sternum of the said hybrid. Half natural size.

Fig. 8. The same of *O. australis*, but of natural size.

Fig. 9. Right scapula (*sc*), coracoid (*c*), and furcula (*f*), with (*h*) hypocleidium, of the supposed hybrid fowl. External view, reduced half natural size.

Fig. 10. The same bones of *Ocydromus.* Of natural size.

ART. XLIII. — *Parasitic* Copepoda *of New Zealand, with Descriptions of New Species.*

By GEO. M. THOMSON, F.L.S.

[*Read before the Otago Institute, 12th November, 1889.*]

Plates XXV.–XXIX.

OUR knowledge of those forms of *Crustacea* which constitute the order *Copepoda* is limited—as far as this colony is concerned—to what is contained in papers of mine published in former volumes of the New Zealand Institute "Transactions"—viz., "On the New Zealand *Entomostraca,*" vol. xi., pp. 251–263; and "New Zealand *Copepoda,*" vol. xv., pp. 93–116. The forms referred to there belong to the free-swimming section of the order, or, if parasitic, they are only ectoparasites, attaching themselves for a limited period of time to the outside of the body of their host, and not losing the power of free movement. Those to which I wish to draw attention in this paper are sedentary creatures (except in very young stages), living in the mouth-cavity, or among the gills or the muscular tissue, or even in the alimentary canal of their hosts, and exhibiting varying degrees of retrogression in their development. Indeed, in the very greatly degraded forms belonging to the families *Condracanthina* and *Lernæopodidæ,* the external form and structure have become so altered and degenerated that it is only by a study of the individual development that their affinities can be determined. In the present paper no attempt in this direction is made. The object is merely to record the occurrence of various species of these parasites, and thus to widen the ever-extending field of our knowledge of the fauna of these islands.

The material available for my purpose has been derived from various sources. Several specimens have been secured by myself, chiefly on fishes bought for household use. A few were obtained during a whaling cruise by the captain of the barque "Splendid"; unfortunately there is no record with these to show from what host the specimens were taken. Mr. A. Hamilton has very kindly sent me, from time to time, specimens taken from various fishes caught at Napier. Lastly, Professor Parker placed at my disposal the material accumulated in the Otago Museum by himself and Professor Hutton.

The only species hitherto described from New Zealand seas are five in number, and belong to as many distinct genera. It is rather remarkable that Heller, during the stay of the "Novara" in Auckland, should only have obtained three species, when it is considered how much attention he paid to this order. The forms now recorded and described bring up the number of species to 24, and of genera to 16, and include representatives of all five families of parasitic *Copepoda*. It is evident that these represent only a small proportion of the species which may be looked for in our seas. No doubt many more species will be discovered as the habits and life-histories of the fishes of the colony are more closely investigated. The present contribution is a mere starting-point.

Fam. CALIGIDÆ.

Genus **Lepeophtheirus**, Nordmann.

1. *Lepeophtheirus huttoni*, n. sp. Plate XXVIII., fig. 10, *a–c*; Plate XXIX., *a–m*.

Male.—Body flat and depressed. Cephalothorax semi-orbicular, abruptly truncate behind; outer margin with a finely plumose fringe. Frontal lobe slightly hollowed in the middle of the front margin; distinctly separated at the sides from the cephalothoracic shield. Hind portion of thorax hardly half the width of the cephalothorax. Fourth segment with wide semi-lunate dorsal lamellæ. Genital segment about as broad as preceding, produced posteriorly into two wing-like projections, each bearing at its outer extremity a pointed and toothed appendage. Abdomen long, narrow, and 2-jointed. Caudal lamellæ hardly shorter than last joint of abdomen.

Female.—Body somewhat arched above. Cephalothorax narrowed in front, and gradually broadening out behind, its posterior extremity being curved inwards. The whole of the margin is somewhat turned inwards. The hind part of the body is rather narrower than in the male, and the lamellæ of the fourth segment are not so greatly developed.

The oviferous tubes are broken off in my specimens, so that I cannot estimate their length.

The *first antennæ* are very small and 2-jointed; the terminal joint consisting of a slender tapering seta, while the basal one broadens out to its junction with the frontal lamella, with the incurved margin of which it appears to be anchylosed. The *antennæ* of the *second pair* are in the form of strong claws, 2-jointed, and with the joints somewhat flattened. The *mouth sucker* is stout and rather distinctly segmented in the middle. At its sides stand a pair of bifurcate teeth, which are strong, chitinous, and dark-brown in colour: from their position these are probably modified maxillary palps. The *first foot-jaws* are long and slender, the second joint tapering to a long weak extremity, and bearing a slender seta. The *second foot-jaws* are strong and 2-jointed. The *sternal fork* is bifurcate; the upper branch on each side rather short and rounded; the lower again shortly 2-branched at its extremity.

The *legs* of the *first* pair are 1-branched; branch 2-jointed (unless the basal joint, which appears to be anchylosed to the sternum, be considered to be a third). The terminal joint bears three plumose setæ on its outer margin, and at its extremity a long nearly-straight spine and two 3-pronged spines. These latter are very peculiar and anomalous organs, and quite unlike any appendages I have seen in other animals of this class. I have accordingly given figures of them considerably magnified (Plate XXVIII., fig. 10, *b*).

The *legs* of the *second* pair are 2-branched. Outer branch 2-jointed and in a continuous line with the basal joint, stretching transversely across the body of the animal; its terminal joint bears 4 strong chitinous spines directed outwards, 1 short (plumose) seta at its extremity, and 3 short and 1 long setæ directed inwards. (All the setæ on the legs of these animals—unless otherwise specified—are beautifully plumose.) The inner branch is 3-jointed, and stands at right-angles to the outer: its first joint bears a seta on the inner margin; the second has 2 setæ, also on the inner margin, and has the outer margin a little dilated; the last joint bears 6 setæ, which diminish in length from within outwards.

The *legs* of the *third* pair are 2-branched, somewhat similar to the preceding pair, but having very large and wide basal plates. Outer branch with 2 powerful hooked chitinous spines on the first joint, and 3 small spines and 5 setæ on the second joint. Inner branch with the first joint simple, rounded, and fringed on the margin; second joint widely dilated on the outer margin, and with a long seta on the extremity of the inner margin; last joint very small, rounded, and with 3 short setæ.

The *legs* of the *fourth* pair are 1-branched. Branch apparently 2-jointed, with the second joint bent nearly at right angles to the first. On magnifying it, however, more strongly, this terminal joint is itself seen to be 3-jointed: the first and second of these smaller joints each end in a spine on the outer margin, while the last bears 3 spines at the extremity. All three joints are fringed on their outer margin by a comb-like row of fine teeth. Perhaps this 3-jointed part is really the branch, the preceding segment being the elongated basal joint. At any rate, in figures of numerous species given by Kroyer this character is very persistent.

The *caudal lamellæ* are very long and slender, many times longer than they are broad. Their anterior part, for over a third of their length, is much broader than the posterior two-thirds. Each is furnished with several short spines, especially near the extremity. The last abdominal segment also bears two spines on the median line, which mark the position of the anus.

The total length of the animal, to the extremity of the caudal lamellæ, is 12–13mm.

Hab. Found, along with *Penella*, on a sword-fish, *Histiophorus herschelii*. (Otago Museum.)

Genus **Nogagus**, Leach.

1. *Nogagus elongatus*, Heller ("Reise der 'Novara:' Crustacea," vol. ii., p. 206; pl. xx., fig. 5).

This species, which is fully described and figured in detail by Heller in the report of the *Crustacea* collected during the voyage of the Austrian frigate "Novara," is probably, as he suggests, the male of *Pandarus dentatus*, having been taken along with that species from a shark caught at Auckland. Indeed, it is almost certain that the genus *Nogagus* consists only of the males of the various forms, of which the females are described under the generic names of *Pandarus*, *Echthrogaleus*, &c.

2. *Nogagus validus*, Dana (?).

This species is recorded by Dana as taken from a shark, north-east of New Zealand. The following is the brief description given:—

"Carapace a little oblong, oval; second segment with the sides prolonged backwards, third and fourth transverse, subequal, half as wide as carapace. Feet of second pair very short, cheliform, immovable; finger short, truncate, movable finger obtuse. Abdomen 2-jointed, anterior segment subquadrate. Posterior angles a little prominent, second segment short, transverse, the angles obliquely truncate. Caudal

stylets rather large, lamellar or little oblong; setæ three, plumose."

It is impossible from such a description to recognize the species referred to. I regret also, in absence of Dana's work, that I am unable to give exact references of this species. The same remark applies to *Pandarus brevicaudis* and *Specilligus curticaudis*, referred to further on.

Genus **Dinematura**, Burmeister (*Dinemoura*, Latreille).

1. *Dinematura affinis*, M.-Edw. ("Hist. Nat. de Crustacées," vol. iii., p. 465; pl. 38, figs. 15–18).

This species is briefly described by M.-Edwards as follows:—

"Species extremely like the preceding (*D. alata*), but having the posterior margin of the elytroid plates sinuous, the terminal lobes of the thorax somewhat narrowed and without the horny tooth at the end, and the abdominal appendages of the female large, oval, as long as the abdomen itself, but not exceeding the thorax. From New Zealand seas."

I have not met with this species, which is figured by M.-Edwards, and is very different in appearance from the following three species described by me.

2. *Dinematura hamiltoni*, n. sp. Plate XXV., fig. 1, *a–j*.

Male.—Whole body somewhat elevated dorsally. Cephalothorax rather square in front, nearly half as long as body, a little broader than long, rounded behind and ending in rather obtuse angles. Frontal lamina extending across about two-thirds of the cephalothorax. Penultimate segment of thorax short, with rounded lateral lobes. Last thoracic segment nearly three times as long as broad, with wide lateral wings. Genital segment short. Abdomen nearly square, only one joint apparent from above. Caudal lamellæ elongate. Fourth pair of feet 2-branched, each branch 2-jointed, terminal joint furnished with short, simple, soft spines.

Length of body, 9mm.

Female.—Whole body rather flattened. Cephalothorax two-thirds as long as body. Dorsal lamellæ of penultimate thoracic segment only two-thirds as long as hind portion of body; ultimate thoracic segment relatively shorter than in male. Fourth pair of feet 2-branched, each branch consisting of two rather large rounded lamellæ.

Length of body, 12–15mm.; length of oviferous tubes, 30–35mm.

The *antennæ* of the *first pair* are normally formed, the 1st broad flat joint being furnished with numerous stout fringed spines; the 2nd joint ends in several smaller spines and one longish seta. The *antennæ* of the *second pair* are apparently

3-jointed, the 2nd joint being however very indistinctly marked by a short spine. The *oral proboscis* is normally developed; the extremity of the mandibles ends in a finely-serrate margin; the palp is 2-jointed. The *first foot-jaws* are long and slender; the terminal hook-like joint bears about its middle a stout, fringed, blunt spine, and somewhat nearer the end a tuft of 5 setæ. The *second foot-jaws* very stout and indistinctly 2-jointed.

All the *thoracic feet* are 2-branched. In the *first* pair both branches are 2-jointed: the outer branch has a large basal joint produced rather obliquely into a tooth-like spine; the 2nd joint bears 4 spines and 3 plumose setæ:* in the inner branch the 2nd joint bears 3 setæ. In the *second* pair both branches are 3-jointed: of the outer branch the 1st joint is elongated and bears a long seta on the inner margin; the 2nd is finely fringed along its outer edge—which ends in a stout spine—and bears a seta on its inner edge; while the terminal joint bears 3 spines and 5 setæ: of the inner branch the joints are subequal in length; the 1st bears on its inner margin one long seta, the 2nd bears 2 on the same margin, while the last has 6. In the *third* pair the outer branch is 3- and the inner 2-jointed; in the outer the 1st joint ends in a spine on the outer margin and carries a long seta on the inner; the 2nd joint is shorter, but otherwise similar; the 3rd ends in 3 spines and bears 5 setæ on its inner margin: of the inner branch the 1st joint is terminated on its inner margin by 2 long setæ, while the 2nd joint has 4 such setæ.

The *fourth* pair of feet in the *male* consists of 2 short branches, each 2-jointed, but having no plumose setæ; in the outer branch the 1st joint is obliquely produced into a short spine on its outer margin, the 2nd joint bears 7 spines; in the inner branch the 1st joint ends in a spine on its inner side, and the 2nd bears 4 spines.

In the *female*, the same limb consists of 4 broad, flat, gill-like lamellæ, each branch bearing a short rounded, and an elongated oval, lobe; the margin of all these lobes is quite entire, and has no trace of spines or setæ.

Each *caudal lamella* has its outer edge incurved and produced into a tooth, from below which a short spine springs; the inner edge is smooth and rounded, while the extremity bears 3 spines.

Colour dark greyish-brown.

Hab. Found on a large shark (species not stated) by Mr. A. Hamilton, of Napier, after whom I have much pleasure in naming the species.

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* Unless otherwise specified all the setæ on the thoracic feet of *Dinematura* are finely fringed, like feathers.

3. *Dinematura neo-zealanica,* n. sp. Plate XXV., fig. 2, *a–d;* Plate XXVI., fig. 1, *a–c*.

Male.—Body nearly quite flat. Cephalothorax nearly round and half as long as the body, posterior angles acute and curved inwards. Penultimate thoracic segment short, curved posteriorly, and rather acute at the outer margins. Last thoracic segment nearly as broad as long, posterior margins ending in a short tuft of setæ. Abdomen not half as long as preceding segment, and only one-third as broad, 2-jointed; 1st joint short, 2nd nearly quadrate. Caudal lamellæ half as long as last segment of thorax, narrow. Feet of *fourth* pair 2-branched, each branch furnished with plumose setæ.

Length, 5–6mm.

Female.—Body flattened. Cephalothorax not half as long as body, rounded at its posterior lateral angles, the posterior margin strongly toothed on the back. Dorsal lamellæ of the penultimate thoracic segment wing-like, nearly square, as broad as the cephalothorax, and reaching back to the genital segment. Dorsal lamellæ of last thoracic segment oblong, rounded and smooth, reaching almost to end of caudal lamellæ. (The extremely broad, wing-like lamellæ of this species give the females a very square form.) Fourth pair of feet 2-branched, each branch 1-jointed, joints flattened and furnished with a few very short spines.

Length, 9–10mm.; length of oviferous tubes, 20–25mm.

The *first antennæ* are normal; the flattened 1st joint however bears more numerous fringed spines than is the case in the preceding species; the elongated 2nd joint ends obliquely and bears 5 simple slender spines. The *second antennæ* are similar to those of the preceding species, but are more strongly hooked, and are distinctly 3-jointed. In the *foot-jaws* of the *first* pair the two joints are sub-equal in length, the basal one being considerably the stoutest; the 2nd joint at about two-thirds of its length bears a curved fringed spine, much smaller than the corresponding organ in *D. hamiltoni,* and distinctly jointed on to a short stalk; behind it, on the joint which bears it, is a roughened tubercle; the slender continuation of this 2nd joint is provided with a finely-serrated fringe reaching nearly to the end, which is strongly hooked. The *foot-jaws* of the *second* pair are very stout, and in the *males* end in a strong horny hook, which is brown-coloured, and so contrasts in a marked manner with the whitish-yellow colour of the rest of the body.

All *four pairs of feet* are 2-branched. In the *first* pair both branches are 2-jointed: the outer branch has the first joint nearly as long as the inner branch; its outer margin is dilated, and ends in a stout spine; the 2nd joint has 4 spines and

3 setæ: of the inner branch, the 1st joint has entire margins, the 2nd is finely serrated on the outer margin, and bears 3 long setæ directed inwards. The *second* pair has both its branches 2-jointed, but the outer branch has traces of a division in its terminal joint: in this branch the 1st joint ends in a spine on the outer and a seta on the inner margin: the 2nd joint has a seta on the middle of the inner margin (which probably marks the division-line between the 2nd and 3rd joints), 5 setæ round the extremity, and 4 spines on the outer margin, which is also furnished with a finely-serrated fringe: in the inner branch the 1st joint ends on the inside in a seta, while the 2nd joint bears 7 setæ towards its extremity. The *third* pair of feet has both branches 3-jointed: the outer branch has the 1st and 2nd joints each ending in a spine on the outer and a seta on the inner margin; the 3rd joint has 3 spines on the outer margin and 5 setæ round the extremity: the inner branch has its 1st joint provided with a seta on the inner margin, the 2nd joint with a spine on the outer and a seta on the inner margin, and the 3rd has 4 setæ round the extremity. The *fourth* pair of feet in the *male* has the outer branch 3-jointed, and the inner 2-jointed: in the former the 1st and 2nd joints end in a strong spine on the outer and a seta on the inner margin; the 3rd joint has 3 teeth on the outer margin, and 4 setæ at the extremity: in the inner branch the 1st joint ends in a long seta on the inner margin, and the 2nd has 4 setæ; both joints are finely fringed on the outer margin. In the *female* each branch consists of a single joint, but the outer is deeply notched as if showing traces of a division: the outer branch is oval in form, its outer margin being produced about the middle into a strong spine; towards the end it bears 4 or 5 spines and has traces of denticulation along its inner margin: the inner branch is shorter than the outer, and is also denticulated with about 7 slight notches.

The last thoracic segment in the *female*, when seen ventrally, ends in a pointed lobe on each side, which projects beyond the extremity of the dorsal lamellæ, and reaches as far back as the end of the caudal lamellæ.

Hab. Numerous specimens of this species were obtained for me by the captain of the whaling barque "Splendid," presumably off a shark; unfortunately he omitted to record the host.

4. *Dinematura carcharodonti*, n. sp. Plate XXVI., fig. 2, *a–d*.

Female.—Body only slightly arched upwards. Cephalothorax one-third as long as body, nearly round, rather broader than long, with a very distinct marginal flange; posterior angles sub-acute. Hind portion of the body long and narrow,

very distinctly separated from the front portion by a narrow constriction between the 2nd and 3rd thoracic segments. Frontal lamina distinct, extending across more than half the front of the carapace. The dorsal lamellæ of the penultimate thoracic segment are square-shaped in front and rounded behind. Under them the dorsal lamellæ of the last thoracic segment project to twice their length on their outer margins, the inner being much shorter. The abdominal segments also bear rounded lamellæ, which are greatly developed and project over the bases of the caudal lamellæ. The hind part of the body is considerably inflated below. The abdomen is very short, and nearly square in shape. Caudal lamellæ very similar in appearance to those of *D. hamiltoni*.

Colour, nearly white. Length, 20–22mm.; length of oviferous tubes, about 50mm.

Both pairs of *antennæ* have a close resemblance to the same organs in the preceding species. The *foot-jaws* are very similar to those of *D. hamiltoni*, the terminal portion of the 2nd joint being however more contracted, and the secondary spine jointed on to a short pedicel as in *D. neo-zealanica*. The *feet* are very similar in the number of joints, spines, and setæ to those of the first-named species, differing only in the shape of the joints. In the *first* pair the 1st joint of the outer branch is obliquely pyriform, and is marked on its outer margin by three rudimentary division-lines. In the *second* pair the 1st joint of the outer branch ends in a spine on its outer margin. Those of the *third* pair exactly resemble those of *D. hamiltoni;* while in the *fourth* pair the only difference lies in the form of the lamellæ, which in this species are long and narrow, and bear 1 minute spine on the inner margin of the inner branch, and 5 on the outer margin of the outer branch.

Hab. Numerous specimens (of females only) were taken from the ventral surface of the tail of a white shark—*Carcharodon rondeletii*,—and are preserved in the Otago Museum.

This species is very nearly allied to, if not identical with, *D. lamnæ*, Johnston; but the description and figure of that species in Baird's "British Entomostraca," p. 206 (the only accessible one to me), is imperfect and insufficient.

Genus **Echthrogaleus,** Steenstrup and Lütken.

1. *Echthrogaleus braccatus* ("Reise der 'Novara:' Zool.," vol. ii., p. 197; pl. xx., fig. 3).

Dinematura braccata, Dana ("U.S. Expl. Exped.: Crust.," vol. xi., p. 1370; pl. 95, fig. 4).

The *female* of this species was originally described by Dana. In "The Voyage of the 'Novara'" Heller describes and

fully figures the *male*. Both sexes were taken by Heller off an undetermined species of shark caught at Auckland. I have not met with this species.

Genus **Cecrops**, Leach.

1. *Cecrops latreillii*, Leach. Pl. XXVI., fig. 3, *a–f*.

This well-marked and well-known form appears to be the only species of the genus. M.-Edwards ("Hist. Nat. Crust.," vol. iii., p. 474) records it as being found on the branchiæ of the tunny (*sur les branchies du thon*), but, with this exception, which may have been stated in error, it is invariably found as a parasite on sun-fishes of various species. Thus round the English coasts it is frequently taken on the gills of *Orthagoriscus molæ* (Baird: "Brit. Entomostraca," p. 293). It is also recorded from the same species taken on the east coast of the United States. On the Pacific coast of the States it occurs on the gills of *Diodon*.

The body of this animal is about an inch long, and is thick and short. The carapace bears two rounded prolongations in front, which represent the frontal lamellæ of the preceding genus, and which in this species are rather closely anchylosed to the cephalothorax. The penultimate thoracic segment bears a dorsal shield notched at the posterior margin, which corresponds to the dorsal lamellæ in *Dinematura*. The last segment of the thorax bears a very large dorsal shield, deeply notched on the hind margin, and which extends beyond and completely covers the abdomen. Seen from the underside the abdomen is dilated and 2-lobed behind, and is covered in front by the greatly-enlarged bases of the fourth pair of feet. The *first antennæ* are small, and are produced at the angles of the frontal lamellæ. The *second antennæ* are powerfully developed, and end in strongly-curved brown horny hooks. It is by means of these organs and the powerful hooks of the *second foot-jaws* that the animals attach themselves to their hosts. The *oral proboscis* is relatively very short, as the animal appears to bury itself rather deeply in the tissues of its host. The *feet* are small, and bear either short spines or setæ; but the latter, though often finely serrated along their edges, never bear the feather-like fringes of the same organs in *Dinematura*. In the first *three* pairs both branches are 2-jointed. They do not end in hooks as stated by M.-Edwards, but in each case the short inner branch bears 3 setæ and a few (except in the *first* pair, which has none) short spines on the terminal joint. In the *first* pair the outer branch ends in 3 setæ and 4 spines; in the *second* pair the 1st joint ends in a powerful curved spine, while the 2nd bears several marginal setæ and small spines; in the *third* pair it ends in 2 (or 3) setæ. In the *fourth* pair the basal joint is developed

into a broad flat plate, bearing a very small 1-jointed branch near its outer edge. Inside of this, however, is a very distinct pointed lobe not clearly disarticulated from the basal lobe, which probably represents the imperfectly-developed inner branch of this pair of feet. The caudal lamellæ are extremely small and inconspicuous. The oviferous tubes are hidden in a remarkable manner. Instead of projecting in the form of long filaments, as is the case in most animals of this class, they are looped up into a dense mass, which lies between the abdomen and the dorsal buckler on each side.

Hab. Several specimens were obtained from the mouth of a sun-fish (*Orthagoriscus molæ*), which was taken in Otago Harbour. (Otago Museum.)

Genus **Pandarus**, Leach.

1. *Pandarus dentatus*, M.-Edwards ("Hist. Nat. de Crust.," vol. iii., p. 469; pl. 38, fig. 19).

This species, originally recorded as taken near Tongatabou, is briefly described by M.-Edwards as follows:—

"Species closely allied to the preceding [i.e., *P. vulgaris*], but having the posterior margin of the carapace nearly straight and strongly toothed in the middle, and the dorsal lamellæ of the first segment of the thorax more rounded and shorter, not quite reaching to the middle of the penultimate thoracic shield; last segment of the thorax and the abdomen as in the preceding species."

Heller ("Reise der 'Novara': Zool.," vol. ii., p. 206) records having taken this species on a shark in Auckland. I have not met with it.

2. *Pandarus armatus*, Heller. Plate XXVII., fig. 1, *a–f*. ("Reise der 'Novara': Zool.," vol. ii., p. 202; pl. xix., fig. 4.)

This species was described and figured by Heller from female specimens taken from a dog-fish (*Scyllium africanum*), from the Cape of Good Hope. The following is the brief specific diagnosis given by him:—

"Cephalothorax shorter than the rest of the body, somewhat narrow in front, slightly excavated behind, with short angles, posterior margin armed with 10 acute teeth; second segment with elongate-oval wings, 4-toothed behind; two following segments with acute median tubercles placed in front of the incision. Genital segment sub-quadrate, narrower behind, with posterior angles acute, tail oval, styles twice as long. Length of body = 8mm."

The detailed description given by Heller is very full and fairly accurate, as are the drawings of those parts figured. The following are points in which my specimens either differ from Heller's, or which he has not described:—

In the first place, all the specimens examined by me are distinctively coloured, the males being of a uniform yellowish colour, while the females are more or less of a deep-brown hue. In some, nearly the whole upper surface is of a fine blackish-brown colour; in others, the pigment is broken up into scattered but somewhat symmetrical patches on the cephalothorax and various dorsal lamellæ. All my female specimens are about the same size, viz., 8mm., and the oviferous tubes are about the same length.

The *male* form of the species, according to Heller, is not known, though he thinks "it is highly probable that *Nogagus latreillii* is the male, because similar spine-like projections occur along the back in the median line, just as they do in this female form."

M.-Edwards's description of the species ("Hist. Nat. de Crust.," vol. iii., p. 459) is not very satisfactory:—

"*Nogagus latreillii.* Frontal lamella greatly excavate; carapace very large, and exhibiting on the posterior margin on each side, very near the postero-lateral angle, a rounded lobe which appears to belong to the first thoracic segment. The first free articulation of the thorax is terminated laterally by similar lobes, which are however very large and reach to the middle of the penultimate thoracic segment; this segment bears similar small prolongations, which are almost completely hidden under the preceding lobes. Last segment of thorax large, and armed on each side with two great conical prolongations, which are directed conically backwards. Abdomen very short, 2-jointed, and terminated by rather large natatory lamellæ."

Kroyer ("Bidr. t. Kundsk. om Snyltekrebsene," p. 242) describes *N. latreillii* and figures the female. Unfortunately, his descriptions, being in Danish, are incomprehensible to me.

I have drawn (Plate XXVII., fig. 1, *c*) a specimen of the form taken along with the females of *Pandarus armatus*, and which I assume must be the male of that species. The following is a brief description:—

Cephalothorax rather broader than long, less than half the length of the body; posterior margin nearly straight, and toothed as in female but not so strongly, rather rapidly contracted into somewhat acute arcuate postero-lateral angles. Two succeeding segments short and only slightly produced into lateral wings. Last segment of thorax not more than half as broad as cephalothorax, rather longer than broad. Abdomen about one-third as wide as preceding segment, 2-jointed, last joint the longest, and produced on the median line. Caudal lamellæ half as long again as abdomen, narrow, and each ending in 4 setæ.

Fourth pair of feet 2-branched; inner branch 2-, outer

3-jointed. In the inner branch the 1st joint bears a long plumose seta on its inner margin, and the 2nd joint has 5 plumose setæ round its extremity. In the outer branch, the 1st joint bears a similar seta on the inner margin, while the outer is produced obliquely into a long stout spine; the 2nd joint is similarly furnished though smaller; while the 3rd bears 4 spines on its inner side and 3 spines at its extremity.

Length, about 5mm.

Hab. Numerous females and one or two males were obtained by the captain of the whaling barque "Splendid," presumably off a shark. The specimens taken on this cruise were got off the coast between Banks Peninsula and Otago Heads.

3. *Pandarus brevicaudis*, Dana (?).

This species is recorded as taken from a shark north-east of New Zealand. The description given is brief and unsatisfactory.

Genus **Specilligus**, Dana.

1. *Specilligus curticaudis*, Dana.

This is recorded as taken from a shark north-east of New Zealand.

The genus is considered by Professor A. Gerstaecker (Bronn's Thierreich, "Crustacea," p. 724) as very nearly related to, if not identical with, *Nogagus*. The description of the only species as given by Dana is brief and unsatisfactory.

Fam. DICHELESTHINA.

Genus **Anthosoma**, Leach.

1. *Anthosoma crassum*, Steenstrup and Lütken. Plate XXVII., fig. 3.

Caligus crassus, Abildgaard.
Anthosoma smithii, Leach.

The occurrence of this species in New Zealand is recorded by Mr. T. W. Kirk, in "Trans. N.Z. Inst.," vol. xx., p. 31, the paper being accompanied by a good figure of the animal. The specimens noticed by Mr. Kirk were taken from the gill-covers of the porbeagle shark (*Lamna cornubica*). The description given is taken from Baird's "British Entomostraca," pp. 297–8. The analogies of the cephalic organs given by Baird and Milne-Edwards are not, however, quite correct. The organs which project from the front of the cephalothorax, and which serve to anchor the parasite firmly into the tissues of its host, are not the first pair of foot-jaws, but the second pair of antennæ.

The first foot-jaws are of remarkable shape, and I have figured one of them. They are 3-jointed; the basal joint is stout and strong; the 2nd joint is elongated, flattened, and flanged on the inner side, and produced at the distal end into a pointed knob, round the extremity is a line of short spines surrounding it like a collar; the last joint is in the form of a round knob obliquely striated in a longitudinal direction, and having two lines of short spines which converge at its extremity. I cannot suggest the origin of this remarkable development, or its present use.

Hab. Numerous specimens taken from the upper jaw of a porbeagle shark—*Lamna cornubica* (Otago Museum). Also a number from the same kind of shark taken at Napier by A. Hamilton. According to Gould this species has been taken on the mackerel-shark—*Lamna punctata*—on the coast of Massachusetts, U.S.A.

Genus **Lernanthropus**, Blainville.

The animals of this genus are chiefly remarkable for the abnormal development of the third and especially of the fourth pair of thoracic feet, which are produced into the form of cylindrical or lamellate appendages under the body. The first and second pairs are very small. The anterior antennæ are very small, while the second pair are developed into hooked claws by which the animals attach themselves to their host.

Owing to the very varying extent to which the parts of the thorax are developed, there is great diversity of form among the different species.

1. *Lernanthropus percis*, n. sp. Plate XXVII., fig. 2, *a–j*.

Female.—The whole body of this species is about one and a half times as long as it is broad. Seen from above, the head is somewhat distinctly separated from the thorax, and is about subquadrate in form: its lateral margins are slightly dilated into two rounded lobes. The thoracic portion is broadly winged, the first segment showing a shoulder-like protuberance on each side, and the second being produced backwards into acute angles. The dorsal shield is about as broad as the thorax, about half as long as the whole body, rounded behind, and with a slight notch in the middle of the posterior margin.

Seen from below, two-thirds of the lower surface is covered by the large lamellæ of the third pair of legs, which do not, however, reach quite to the extremity of the dorsal shield, but leave exposed the folded-up ends of the oviferous tubes. Genital segment very short. Abdomen short, thick, rounded, and fleshy, very indistinctly 2-jointed (?), with a small notch

and two minute anal papillæ on the posterior margin. Caudal lamellæ very small, 2-(?)jointed, with two minute setæ at the extremity.

Anterior antennæ not seen. Posterior pair in the form of powerful hooked claws, by which the animal attaches itself to its host; these are 2-jointed, the basal joint being thick and powerful, while the shorter and more curved terminal joint bears a strong tooth on the middle of its inner surface, and behind it two or three rugosities.

First foot-jaws small and not very powerfully developed; the rather slender terminal joint ends in a feebly-chelate manner in two claws, the larger (and outer) of which is finely serrated along its outer margin. The second foot-jaws are strongly developed.

First pair of legs not seen. The second pair are very small, the minute outer branch being free and obliquely oblong, while the inner, which is in the form of a curved lobe, is anchylosed to the horny basal joint. The third pair are developed into large lamellar plates, the outer of which are broadly oblong, and rounded at their extremity, and have the narrower inner plates standing at right-angles against them. The fourth pair are produced in the form of two elongated and curved fleshy lobes, which are shorter than, and are completely hidden by, the lamellæ of the third pair.

Oviferous tubes rather longer than the dorsal shield, but lying slightly folded within its margin.

Length, 4–5mm.; colour, dark-brown.

Hab. A single (female) specimen was found by me on the gills of a blue cod (*Percis colias*).

This species is nearer to *L. scribæ*, Kroyer, in general form than to any other of the many oddly-shaped species of this genus, but differs entirely from it in most of the details of its structure. It is a very distinct form.

Genus **Philichthys,** Steenstrup.

1. *Philichthys xiphiæ,* Stp. Plate XXVIII., fig. 1.

I have several female specimens of this remarkable parasite, which were taken from the skull of a sword-fish (*Xiphias gladius*). Unfortunately, I do not know whether the specimen was taken near Dunedin, or from what part of the coast.

The male of this species, according to Bergsoe, is a long, narrow, *Cyclops*-like copepod, apparently free-swimming in its habits. The female, on the other hand, lives in the bones of the skull of the sword-fish, producing pit-like cavities in the bone-tissue. Not only is the body very numerously segmented, but the segments bear sac-like appendages whose analogies are not easily made out. The oral proboscis—so

distinctively produced in the forms previously referred to—is not found in this genus, nor, indeed, is there any appearance of a mouth-opening. The antennæ, foot-jaws, and three pairs of legs are all represented by sac-like appendages; the fourth pair of legs is quite absent.

Fam. LERNÆODEA.

Genus, **Penella**, Oken.

In the *females* of this genus the body is slender, cylindrical, and much elongated. The head is rounded and somewhat irregular in form, and behind it arise two arm-like lobes. The thorax or neck-part exhibits no segmentation, and is only indistinctly separated from the genital segment. This latter part is greatly elongated, and constitutes the largest part of the body. At its posterior extremity spring the narrow, straight oviferous tubes. The abdomen protrudes as a long, somewhat flattened portion, bearing on both sides a large number of styliform, thread-like appendages. The antennæ and foot-jaws are difficult to distinguish in the head part, as they are more or less hidden by a mass of short slender tube-like processes. Behind the head all four pairs of feet are placed in close succession, and all in a very rudimentary condition.

The *male* is very small, almost spherical in form, and carries on the anterior portion a conical sucker furnished with several styliform appendages, and on the inferior face two pairs of very large sub-cheliform limbs, by means of which he holds on to the female.

1. *Penella histiophori*, n. sp. Plate XXVIII., fig. 2.

In the absence of the full literature of this remarkable genus I advance this species provisionally, as it is very distinct in form from any figured or described in Bronn or Milne-Edwards.

The head is in the form of a rounded cup about 5mm. in diameter, and anteriorly presents a mass of botryoidal or grape-like processes, which are slightly arranged in about four parallel masses. Apparently the mouth-organs are placed among these. The arm-like processes behind the head extend horizontally to a length of 15mm. on each side. Between them and projecting a little posteriorly is a rounded protuberance. The four pairs of thoracic feet are very minute, and each consists of a small sub-acute lobe (somewhat similar to those in *P. sagitta*). The genital segment is separated by an imperfect constriction from the thorax, and is about 65mm. long, increasing in width posteriorly. It shows faint transverse marks throughout its length. The abdomen is

about 18mm. long and 5mm. broad, and is very thickly fringed on both sides with numerous setiform processes. The oviferous tubes barely reach to the extremity of the abdomen, and are very slender and thread-like.

No males were seen.

The average total length of the specimens was about 90mm. (nearly 4in.).

Hab. Found on a sword-fish—*Histiophorus herschelii.* (Otago Museum.)

Genus **Lernea**, Linnæus.

M.-Edwards, and Baird after him, give the characters of the animals comprising this genus as follows :—

Body more or less twisted, and *outré* in appearance, destitute of rudimentary feet. Head furnished with horn-shaped appendages, which are irregularly branched. Ovarian tubes twisted together into rounded masses and placed under the posterior portion of the body. Abdomen large and distorted.

The description is incorrect as far as the appendages are concerned, as all four pairs of thoracic feet are present, although in a somewhat rudimentary condition.

1. *Lernea lotellæ,* n. sp. Plate XXVIII., figs. 3 and 3*a.*

In general appearance this species somewhat resembles *L. branchialis*, but the three cephalic arms are quite simple, and not branched as in that species. The head is small and rounded, each of the three simple arms below it extending to a length of about 4mm. The neck is long and rather narrow, gradually widening below, the lower portion of this segment being greatly dilated and bent completely on itself. At the extremity of this segment the oviferous tubes arise. These are closely coiled up into two masses or rolls, each about 6mm. or 7mm. long. The posterior end of the body is separated distinctly into an oblong abdomen. There is considerable diversity of form in the posterior part of the body, both in the extent to which it is dilated and the amount of curvature exhibited. The whole of this hind portion is more or less covered with a filamentous growth, part of which appears to consist of natural hair-like processes, but which is mainly formed of masses of filamentous *Algæ* and of sertularians. The front part of the body is very hard and horny, but the hinder part is much softer and leathery in consistence. It is probable that as these parasites are attached by the hard head, and have the softer posterior portion projecting on the outside of the fish which they infest, the growth referred to is of the nature of a protective covering, resembling in this respect some of the rather soft-bodied crabs (*Paramithrax*) which are similarly protected.

The total length of my specimens, exclusive of the oviferous tubes, is from 16mm. to 20mm.

Hab. On the gills of the red cod (*Lotella bacchus*). (Otago Museum.)

Fam. CHONDRACANTHINA.

Genus **Lesteira**, Kroyer.

This genus is characterized as follows by Kroyer:—

Head enlarged at the sides as if into two rounded wings, by which the animal is attached; antennæ and rostrum (or buccal protuberance) not very clearly defined. Neck very long, cylindrical, thin in the front, and entirely destitute of all traces of limbs. Genital segment provided behind with two clusters of tubuliform appendages; oviferous tubes straight and somewhat thick. Abdomen rudimentary.

Male not known.

Young, at its earliest stage, furnished with four antennæ, maxillæ and palps, and six feet.

This is perhaps the same genus as is referred to by Cuvier under the name of *Sphyrion* ("Règne Animal," t. 3, p. 257), but of which he only gives the following imperfect character: "Head enlarged on both sides like a hammer; small hooks at the mouth; neck thin, succeeded by a depressed body in the form of a heart, which, besides the two long cords, carries on each side a large bunch of hairs."

1. *Lesteira kroyeri*, n. sp. Plate XXVIII., figs. 4 and 4*a*.

Front part of animal dilated into a thick, wide, float-like body, which is about 55mm. across, and 20mm. wide, inclusive of its protuberances. This tapers to the rounded ends, and seen from behind shows two long and obtusely-pointed projections on its upper margin, and two rounded shorter knobs below. When looked at from the front it is seen that the two long protuberances define the position of the mouth-organs. These are situated on a small protuberance—about 11mm. in width—the upper part of which is dilated into two hammer-like wings, and the lower into two rounded lobes. The former probably represent the antennæ, while above the latter may be seen the mouth-organs, consisting of a conical upper and an under lip, with a small rounded maxilla on each side. This part of the body is soft and fleshy in consistence. From near the middle of it arises the slender neck, which reaches back to a length of 12mm., and connects with the compressed and heart-shaped genital segment. This part of the body is about 20mm. long, 25mm. broad, and about 10mm. thick. Both it and the neck are of very hard and horny consistence, and are absolutely destitute of any traces of limbs. Its surface, though somewhat smooth, bears—in one specimen at

least—several small *Cirripedes* and *Serpulæ*. The bunches of coralline-like appendages at the posterior margin of the genital segment are irregular in form, and equal it in length. The oviferous tubes are thin and nearly straight, or at most only slightly curved, and are about 60mm. long.

The whole length of the animal (exclusive of the oviferous tubes) is about 70mm.

Hab. Taken from the abdomen of a ling (*Genypterus blacodes*), in the tissues of which the whole soft front part of the body was imbedded.

Genus **Chondracanthus**, De la Roche.

The *males* of this genus are very minute, and are found attached under the posterior extremity of the thorax of the females. The body is more or less pyriform in shape, having a very large head and an articulated thorax. They are also provided with very large hooks (posterior antennæ) by which they remain attached to the females.

Females having the body of more or less bizarre form, and furnished with tubercles or lobed processes. Head generally indistinctly separated from the thorax and furnished with two pairs of antennæ. Of these, the first pair are usually short, and 1–(3)-jointed, while the second pair are in the form of hooked claws. The mouth is situated rather far back, and is furnished on each side with a small hooked maxilla. The foot-jaws are small, and end in hooked claws. Two pairs of thoracic feet are developed in the form of bifurcate lobes. The genital segment is usually produced backwards in the form of two lobe-like processes: between these arise the stout oviferous tubes. Between them projects a minute tubercle, representing the rudimentary thorax.

1. *Chondracanthus chilomycteri*, n. sp. Plate XXVIII., fig. 5, *a–d*.

Body rather stout, nearly three times as long as broad. Head small and not distinctly separated from thorax. Thorax divided into two rather distinct parts, of which the anterior is only half as wide as the posterior: the former is elongated and bears on each side two rounded protuberances which project laterally to a small extent: the posterior portion on the other hand is sub-quadrate in form, and bears two rounded protuberances, which project on its ventral face; the posterior extremity on each side is produced backwards to an obtuse lobe. The antennæ, which are broadly falcate in form, are rather closely approximated at their base, and do not reach to the margin of the head on each side. The first pair of thoracic legs are very small, and exhibit distinct segmentation; the second pair are very much larger, and consist only

of rounded two-branched lobes. The minute abdomen is very difficult to distinguish; I could only recognize one articulation, and its extremity appeared to be two-lobed. Oviferous tubes rather stout, hardly exceeding the length of the thick part of the thorax.

Length of body, 6–8mm.; including the oviferous tubes, 9–10mm.

Hab. Taken from the mouth of the porcupine-fish—*Chilomycterus jaculiferus*—by Mr. A. Hamilton, of Napier, to whom I am indebted for much assistance in working out the *Crustacea* of these seas.

2. *Chondracanthus genypteri*, n. sp. Plate XXVIII., figs. 6 and 6*a*.

Body long and narrow. Head laterally compressed, elongated, three times as long as broad when seen in front. Seen laterally it is rounded behind, and in the middle of the front margin protrudes a little at the point of attachment of the mouth-organs. The front part of the thorax is hardly broader than the neck, and is separated from it by a short constricted part or neck. The posterior division of the body is somewhat wider, and bears two pairs of elongated fleshy lobes which are considerably curved inwards towards the median line. Antennæ of first pair small and distinct, rather widely separated at the base and standing out backwards like minute horns. The second pair are produced a little forward in the form of two curved hooks. The mouth-organs are rather prominent. Both pairs of thoracic legs are elongated, and have the branches well defined and projecting somewhat widely to the sides. Abdomen not seen. Oviferous tubes short and stout, not half as long as the body.

Hab. Taken on the gills of the ling—*Genypterus blacodes*. (Otago Museum.)

3. *Chondracanthus lotellæ*, n. sp. Plate XXVIII., fig. 7, *a* and *b*.

Body very short and thick. Seen from the front it exhibits three pairs of fleshy obtuse lobes directed inwards and downwards; above these the head stands out somewhat distinctly. Looked at from the side the lateral lobes are seen to project prominently forward, while along the back are three large fleshy obtuse lobes directed posteriorly and corresponding to those of the sides. Behind the head also is a rounded protuberance. The antennæ are closely approximated, and broadly falcate in shape, lying close to the front of the head and not reaching past its lateral margins. They project forward to a considerable extent, so that the buccal portion is somewhat concave. The two pairs of thoracic limbs are

short, very thick and fleshy, and only imperfectly 2-lobed. Abdomen very small and completely hidden by the posterior lobes of the body. Oviferous tubes rather stout, about twice as long as the body.

Length of body, 5mm.; breadth, 3mm.; length of oviferous tubes, 9mm.

Hab. Found on the gills and abdominal wall of the red cod—*Lotella bacchus*—apparently not uncommon.

Fam. LERNÆOPODIDÆ.

Genus **Lernæopoda**, Kroyer.

Head short and thick, not very distinctly separated from the rest of the body. Thorax not showing any distinct segmentation; genital segment narrow, sac-like. Antennæ of first pair small, springing within the hook-like second pair. Mouth produced into a short but prominent proboscis, on each side of which the free palps of the maxillæ are seen. Foot-jaws of first pair in form of hooked claws. Those of second pair produced under the head in the form of two long arms, which are joined at the extremity into a disc, by means of which the animal anchors itself firmly in the tissues of the host on which it lives. Legs quite wanting. Oviferous sacs nearly or quite straight.

1. *Lernæopoda musteli*, n. sp. Plate XXVIII., figs. 9 and 9*a*.

Head rather small, about one-fourth as long as the body, ovoid in form, considerably longer than broad, and somewhat arched forward. The succeeding segments of the thorax form a very short and indistinct neck, below which is the large, sac-like, elongated, and smooth genital segment. The arms are rather stout at the base, but taper towards their extremity, which ends in a very small attachment-disc; they are considerably longer than the genital segment, and protrude from below the front of the head, so as to make a very acute angle with the rest of the body. Mouth-organs very indistinctly made out. External ovaries rather stout, as long as or longer than the genital segment. Abdominal lobes short, about one-sixth of the length of the segment preceding them.

Total length of the body alone, 5mm.; with the oviferous tubes, 9mm.

Hab. A single specimen taken from the cloaca of the smooth-hound—*Mustelus antarcticus*. (Otago Museum.)

Genus **Brachiella**, Cuvier.

This genus is distinguished from the preceding (and the whole group to which it belongs) in having the cephalo-

thoracic part of the body thin, elongated, and somewhat worm-like. The head therefore seems placed at the end of a long neck. The mouth is at the extremity of this neck, and is formed of a conical rostrum or proboscis, at the sides of which are the free maxillary palpi. The antennæ of the first pair are indistinctly recognizable; those of the second pair are produced as more or less hooked organs at the sides of the rostrum. Behind these are placed the hooked foot-jaws of the first pair. The arm-like second pair are free up to the point and rather long. The genital segment is thick and bag-like, and either oval or quadrate in form. It bears one or two pairs of tube-like posterior lobes or appendages. The oviferous tubes are considerably elongated.

1. *Brachiella parkeri*, n. sp. Plate XXVIII., fig. 8, *a* and *b*.

Head and thorax rather stout, about 2mm. in diameter and 8mm. long, forming a nearly-continuous line with the arm-like appendages, and bent at right angles to the genital segment. Rostrum long and conical, considerably exceeding the antennæ. The latter organs end in a rounded lobe, and have a small pointed joint protruding near their outer extremity. The maxillary palps are 2-jointed, and are directed backwards and outwards. About 3mm. from the extremity of the cephalothorax stand a pair of conical protuberances which show no distinct segmentation: these probably represent the foot-jaws of the first pair. The arms (modified foot-jaws of the second pair) are 17mm. long, and end in a large dark-coloured disc about 3mm. in diameter. The genital segment is pyriform and slightly compressed in shape, being about 11mm. long, 7mm. broad, and 5mm. deep from back to front. At its base and on each side of the anal papillæ two long, narrow, terete appendages about 10mm. long project downwards. The oviferous tubes are long and tolerably straight.

The total length of the animal from the bend of the thorax to the extremity of the oviferous tubes is 33mm.; that of the tubes alone is 21mm.

Hab. Found on the gills of the skate (*Raja nasuta*), and of a stingaree, *Trygon* sp. (Otago Museum.)

I have named the species after Professor T. J. Parker, to whom I am indebted for much of the material referred to in the paper.

It is evident from the list of the fishes from which the foregoing species of parasites were taken that the kinds which are chiefly brought into the various markets by fishermen have hardly yet been examined with the object of ascertaining what

parasites are found on them. I have myself only gathered a few specimens, but a glance at the appended list shows that it is only those kinds of fish which, from their rarity, size, or peculiarity, are collected for museums which have furnished the material examined by me. A close examination of the food-fishes exposed for sale would certainly yield many other kinds of parasitic *Copepoda*, and the present paper may be considered as only an introduction to the subject, showing what is now known.

Host.	Parasite.
Sword-fish (*Histiophorus herschelii*)	*Lepeophtheirus huttoni.* *Penella histiophori.*
Sword-fish (*Xiphius gladius*)	*Philichthys xiphiæ.*
Blue cod (*Percis colias*)	*Lernanthropus percis.*
Red cod (*Lotella bacchus*)	*Lernea lotellæ.* *Chondracanthus lotellæ.*
Ling (*Genypterus blacodes*)	*Lesteira kroyeri.* *Chondracanthus genypteri.*
Porcupine-fish (*Chilomycterus jaculiferus*)	*Chondracanthus chilomycteri.*
Sun-fish (*Orthagoriscus molæ*)	*Cecrops latreillii.*
Smooth-hound (*Mustelus antarcticus*) ..	*Lernæopoda musteli.*
Porbeagle shark (*Lamna cornubica*) ..	*Anthosoma crassum.*
White shark (*Carcharodon rondeletii*) ..	*Dinematura carcharodonti.*
Sharks, species not indicated	*Nogagus elongatus.* *Nogagus validus.* *Dinematura hamiltoni.* *Echthrogaleus braccatus.* *Pandarus dentatus.* *Pandarus brevicaudis.* *Specilligus curticaudis.*
Skate (*Raja nasuta*) Stingaree (*Trygon*, sp.)	*Brachiella parkeri.*
Host not specified; probably species of sharks	*Dinematura affinis.* *Dinematura neo-zealanica.* *Pandarus armatus.*

EXPLANATION OF PLATES.

PLATE XXV.

Fig. 1. *Dinematura hamiltoni*, *male*, × 8: *a*, anterior antenna, × 10; *b*, posterior antenna, × 23; *c*, oral proboscis, × 23; *d*, mandible, × 50, and extremity of same showing the saw-like teeth, × 150; *e*, *first* foot-jaw, × 23; *f*, foot of 1st pair, × 23; *g*, foot of 2nd pair, × 23; *h*, foot of 4th pair (*male*), × 18; *i*, foot of 4th pair (*female*), × 8; *j*, caudal lamellæ, × 8.

Fig. 2. *Dinematura neo-zealanica*, *male*, × 8: *a*, *female*, × 8; *b*, anterior antenna, × 20; *c*, posterior antenna, × 20; *d*, 1st foot-jaw, × 20; *e*, foot of 4th pair (*female*), × 20.

Plate XXVI.

Fig. 1. *Dinematura neo-zealanica, female*: *a*, foot of 1st pair, × 23; *b*, foot of 2nd pair, × 23; *c*, foot of 4th pair (*male*), × 23; *d*, abdomen (*fem.*) from under-side, × 8.

Fig. 2. *Dinematura carcharodonti, female*, seen from above, × 3: *a*, 1st foot-jaw, × 8; *b*, foot of 1st pair, × 23; *c*, foot of 2nd pair, × 8; *d*, foot of 4th pair, × 8.

Fig. 3. *Cecrops latreillii, female*, × 2: *a*, dorsal aspect; *b*, ventral aspect; *c*, foot of 1st pair, × 23; *d*, foot of 2nd pair, × 23; *e*, foot of 3rd pair, × 23; *f*, foot of 4th pair, × 8.

Plate XXVII.

Fig. 1. *Pandarus armatus*: *a*, *female*, dorsal aspect, × 4; *b*, *female*, ventral aspect, × 4; *c*, *male*, dorsal aspect, × 6; *d*, foot of 1st pair, × 40; *e*, foot of 2nd pair, × 40; *f*, foot of 4th pair, *male*, × 23.

Fig. 2. *Lernanthropus lotellæ, female*: *a*, animal seen from above, × 7; *b*, ventral aspect, × 7; *c*, posterior antennæ from below, × 26; *d*, 1st foot-jaws, × 26; *e*, extremity, × 80; *f*, 2nd foot-jaws, × 26; *g*, leg of 2nd pair, × 20; *h*, leg of 3rd pair (from the inside), × 13; *i*, under-side of thoracic shield with lamellæ of the 3rd pair of legs removed, showing (*l*) 4th pair of legs, (*ab*) abdomen and (*ov*) oviferous tubes, × 13; *j*, abdomen, × 20.

Fig. 3. *Anthosoma crassum*: 1st foot-jaw, × 20.

Plate XXVIII.

Fig. 1. *Philichthys xiphiæ, female*, seen from above, × 2.

Fig. 2. *Penella histiophori, female*, nat. size.

Fig. 3. *Lernea lotellæ, female*, × 2: *a*, the same species, but a somewhat different form.

Fig. 4. *Lesteira kroyeri, female*, nat. size: *a*, head of same seen from the front.

Fig. 5. *Chondracanthus chilomycteri, female*, × 5: *a*, anterior antennæ, × 26; *b*, posterior antennæ, × 26; *c*, leg of 1st pair, × 26; *d*, leg of 2nd pair, × 26.

Fig. 6. *Chondracanthus genypteri, female*, × 4: *a*, same in lateral aspect, × 4.

Fig. 7. *Chondracanthus lotellæ, female*, × 3: *a*, same in lateral aspect, × 3.

Fig. 8. *Brachiella parkeri, female*, nat. size: *a*, mouth-organs, × 26 (*r*, rostrum; *an*, antennæ; *p*, maxillary palpi); *b*, conical protuberances representing first foot-jaws.

Fig. 9. *Lernæopoda musteli, female*, × 2: *a*, mouth-organs, × 26.

Fig. 10. *Lepeophtheirus huttoni*: *a*, leg of 1st pair, × 26; *b*, extremity of last joint of same, × 56; *c*, leg of 4th pair, × 26.

Plate XXIX.

Fig. 1. *Lepeophtheirus huttoni*: *a*, *male*, dorsal aspect, × 7; *b*, *female*, ventral aspect, × 7; *c*, antenna of 1st pair, × 26; *d*, antenna of 2nd pair, × 26; *e*, oral proboscis, × 56; *f*, extremity of mandibles, × 26; *g*, foot-jaw of 1st pair; *h*, foot-jaw of 2nd pair; *i*, sternal fork, × 26; *j*, foot of 2nd pair, × 26; *k*, foot of 3rd pair; *l*, lamella of last thoracic segment, × 26; *m*, abdomen, × 26.

III.—GEOLOGY.

Art. XLIV.—*On the Relative Ages of the New Zealand Coalfields.*

By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 3rd October, 1889.*]

In the Hokonui Hills, Southland, in the country between the mouths of the Mataura and Clutha Rivers, and on the west coast of the North Island south of Port Waikato, thin seams of coal are found which are acknowledged to be of Jurassic age. Also, there are at Lovell's Flat, in Otago; round the Manukau Harbour, near Auckland; at the north head of the Kaipara, and in many other places, beds of lignite in which vegetable structure is often recognizable by the naked eye; and these are allowed to be Pliocene or later. Between these dates lie all the valuable coalfields of New Zealand, and the question whether they do or do not belong to a single geological period is one which has been discussed for a quarter of a century without leading to a general agreement. The Geological Survey holds that all these coalfields belong to its Cretaceo-tertiary period; while the late Dr. von Hochstetter,* Sir Julius von Haast,† and myself have maintained the opinion that there are two or more coal-formations in New Zealand. The discovery of Lower Cretaceo-tertiary fossils in the northern part of the colony, and the reports of Messrs. Park and McKay on the localities, have added a new interest to the question; and Mr. McKay has lately given an able and very fair summary of the views held by the Geological Survey Department. He is, however, in my opinion, mistaken in identifying the hydraulic limestone of the north with the Amuri limestone of the south; and, if this be so, his argument for the equivalence of the northern and southern coalfields altogether breaks down. Before giving my reasons for this opinion I wish, as the subject is one of great economic importance and likely

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* "Geology of New Zealand," 1867, pp. 58 and 59.

† "On the Character and Age of the New Zealand Coalfields," Rep. Brit. Association, 1886, p. 643.

to interest persons who are not professional geologists—I wish to make a few remarks on the nature of the evidence by which geologists correlate different strata and ascertain their relative ages.

This evidence is of three kinds—(1) stratigraphical, (2) palæontological, and (3) lithological. Stratigraphical evidence, when complete—that is, when one stratum is seen actually to overlie another without any possibility of this being due to inversion or overthrust—is absolutely decisive as to the relative ages of two sedimentary rocks. Unfortunately, complete evidence can rarely be got. Usually the geologist has to infer the relative positions of two rocks by putting together two or more disconnected sections. This lets in the possibility of an unobserved discordance—that is, a fault or an unconformity—occurring between the sections, and so reduces immensely the weight of evidence. Stratigraphical evidence, to be conclusive, usually requires that a considerable area of country should be mapped in great detail; and this, again, requires a more minutely-accurate topographical map than exists for any part of New Zealand. Until we have geological maps equal to those of the British Islands we must generally receive with caution, and treat as probable, the results arrived at by stratigraphical evidence alone.

With palæontological evidence it is quite different, for here good maps are not necessary, and the fact of two localities being disconnected is of little importance, provided they are both within the same biological province. But palæontology has its difficulties. First, we have the danger of mixing together fossils from different horizons although collected close together; secondly, mistakes may occur from labels having got displaced or mixed, or perhaps forgotten altogether. In these cases the attempt to identify the localities by memory has often led to mistakes. Thirdly, there is the difficulty of correctly identifying species. All these are real difficulties which may prevent accurate results being attained. Still, it has turned out over and over again that when stratigraphy and palæontology have been at variance the mistake has been in the stratigraphy; and this is a clear proof that, on the whole, palæontological evidence is the more reliable. After long and detailed study of the geology of Europe and North America by many geologists, the only case where stratigraphy and palæontology are still opposed is the so-called Colonies of Barrande, in Bohemia; and even here it is thought by many geologists that the stratigraphy is in error.

Lithological evidence is of two kinds—(1) included fragments, and (2) mineral composition. Included fragments of another rock are invaluable for proving relative age when the fragments can be recognized with certainty. Mineral compo-

sition is occasionally very useful in the case of rocks of exceptional composition, such as red sandstones with gypsum; but even here it can only be applied with caution, and in restricted areas. It is a test which decreases in value as the formations compared increase in distance; and when the localities are more than fifty miles apart this kind of evidence is usually of very little weight, especially with the younger rocks, which are rarely widely spread. We know that very dissimilar rocks are now forming round our coasts; we know that one kind of rock can often be traced horizontally into another of quite different mineralogical composition; and we also know that rocks of similar mineral composition have been formed at very different periods of time: consequently lithological evidence has always given way to palæontological evidence whenever they have been opposed—as, for example, with the Old and New Red Sandstones of Britain, which were at first considered as one from similar mineralogical composition, but proved by fossils to be separated by the whole of the Carboniferous period, this palæontological evidence being subsequently confirmed by stratigraphy. In the absence of all other evidence mineral composition is our only guide, untrustworthy though it be; and in the Highlands of Scotland it has defeated the first efforts of stratigraphy. This, however, was with Archæan and Palæozoic rocks, and even here it was palæontology that really overthrew the old stratigraphy.

Bearing in mind, then, the relative values of these three kinds of evidence, we come now to the consideration of the case of the New Zealand coalfields drawn up by Mr. McKay, which will be found on page 55 of the "Reports of Geological Explorations" for 1887–88. Mr. McKay says "that the difficulty is mainly a palæontological one, and that if it were not for the seemingly contradictory evidence afforded by the fossil-collections from different localities, it does not seem that most geologists would doubt the propriety of grouping the coal-bearing beds at various places as the same or equivalent developments of one formation, or of including as part of the same sequence the fossiliferous marine strata that in most cases overlie the coal-bearing beds." Now, I can quite agree with Mr. McKay that *if* the same fauna had been found over the coal at the different localities there would be no great difficulty in considering the coals as all belonging to one formation; but I differ from Mr. McKay in thinking that, as the faunas differ at different localities, there is no difficulty at all in considering them as belonging to more than one formation. I will state the case thus:—

It is a fact admitted by all that the fossils found in the beds immediately over the coal at Waipara, Malvern Hills, and Shag Point (which I will call the Waipara fauna) are

different from those found in the beds which overlie the coal in south-eastern Otago, Whangarei, and Kawakawa (these I will call the Oamaru fauna). The Waipara fauna has not yet been described and catalogued, but it includes *Plesiosaurus* and other marine saurians, *Ammonites*, *Belemnites*, *Inoceramus*, and an extinct genus of gastropods called *Conchothyra*. There are no living species of Mollusca. The flora has been described by Baron von Ettingshausen, who considers it to be Tertiary. We thus have here a parallel to the Laramie fauna and flora of North America; but our fauna is more closely related to that of the Fox Hills Group, below the Laramie. The Oamaru fauna contains remains of cetaceans, penguins, and turtles, as well as a number of other fossils, which have been catalogued in the "Quar. Jour. Geol. Soc. of London," vol. xli., p. 554; and in the "Proc. Lin. Soc. N.S. Wales," 2nd series, vol. i., page 205. Among them are a few living species, but no extinct genera, of Mollusca. It is acknowledged to be a Tertiary fauna, and, according to Professor Tate, represents the Eocene fauna of Australia ("Jour. R.S. of N.S. Wales," vol. xxii., p. 245). In the Waipara district these two faunas are in superposition, and the Oamaru fauna lies above the Waipara fauna, the two being separated by the Amuri limestone, which contains few fossils, none of them very characteristic.

North of Auckland there is a limestone, called the hydraulic limestone, which lies over the Oamaru fauna at Whangarei and Kawakawa, as well as at Pahi and Paparoa in the northern Kaipara district; but in the upper Waitangi valley, near Hokianga, and at Batley in the Kaipara, this limestone lies directly over the Waipara fauna. It is allowed that the hydraulic limestone always overlies the Oamaru fauna conformably, but Mr. Park states that it is unconformable to the series of beds containing the Waipara fauna at Paparoa, Pahi, &c., for the very good reason that "at different places it is found lying on various members of that series" ("Rep. Geol. Exp.," 1886–87, p. 229). Mr. McKay says that he could not convince himself of this unconformity; but he attempts no disproof of Mr. Park's statement, and in the last paragraph of his report he seems to admit that an unconformity is quite possible. Sir James Hector, who discovered these beds at Pahi, considered them to be of Jurassic age, and Mr. Cox informs me that he is of the same opinion, and this of course implies that they are unconformable to the overlying beds.

Now, the officers of the Geological Survey identify this hydraulic limestone with the Amuri limestone of the Waipara, and if this correlation is correct it follows that the Amuri limestone overlies the Waipara fauna at the Waipara and at Waitangi, while it also overlies the Oamaru fauna at Wha-

ngarei, Pahi, &c.; and in this way it is sought to show that the two faunas are of the same age. But what is the evidence for this correlation? Mr. McKay says, "The Amuri (hydraulic) limestone as seen at Limestone Island, Whangarei, is, to say the least of it, remarkably like the Amuri limestone at Amuri Bluff, and the few fossils that have been found in that rock at Whangarei, so far as they go, prove the identity of the two." So that the correlation rests upon the lithological resemblance of two argillaceous limestones more than three hundred miles apart, and on a few fossils of which Mr. McKay gives no list. Many of the fossils reported years ago as coming from the Amuri limestone—including the sharks' teeth collected by Mr. H. Ingles and reported by myself—probably come from a higher level. At any rate, they are all found at higher levels, and the only fossils I know myself from the limestone are some undescribed *Foraminifera* and *Ostrea subdentata*. Mr. McKay has also added *Pecten williamsoni* and *Rhynchonella squamosa*, both of which also belong to the Oamaru fauna ("Rep. Geol. Exp.," 1886–87, p. 90). But, supposing all the identifications to be correct, and the horizon indisputable, still the evidence is not important, and by no means proves the identity of the two limestones. *O. subdentata* is the only characteristic species, and Mr. McKay does not say that he obtained this at Whangarei; and, if not, there is nothing to prevent the hydraulic limestone from belonging to the upper part of the Oamaru series. Mr. McKay does not say that the fossils from the Amuri and hydraulic limestones are not found at other horizons; but, if they are so found, then they are not exclusively characteristic of the Amuri limestone, and cannot be used for identifying it.

To make my meaning clearer, suppose the following distribution of fossils:—

The Oamaru series contains species A, B, C.
The Amuri limestone contains species C, D, E.
The Waipara series contains species E, F, G.

To prove an equivalent for the Amuri limestone we can only use D. A bed in another locality containing E might belong either to the Waipara series or to the Amuri limestone, a bed with C to the Oamaru series or the Amuri limestone. The last is the case with the hydraulic limestone, and, as it overlies beds containing A and B, it is with the Oamaru series and not with the Amuri limestone that we must correlate it. In fact, if all the fossils said to come from the Amuri limestone really do so they would only show that the Amuri limestone forms the base of the Oamaru series in the Waipara district, and would not prove it to be the equivalent of the hydraulic limestone. The palæontological evidence is there-

fore opposed to the view of the Survey. So also is the stratigraphical evidence; for the Amuri limestone, which underlies the Oamaru series in the Waipara, cannot overlie it at Whangarei and Pahi, as the theory of the Geological Survey implies. The same rock cannot both overlie and underlie equivalent series. A simple explanation of the facts is that the hydraulic limestone at Pahi overlaps the lower beds of the Oamaru series, and lies directly on the Waipara series at Batley; and if this is the case in the Kaipara the same explanation will probably hold in the Bay of Islands and Hokianga districts. The lithological evidence, I need hardly say, is worthless, for the rocks are so widely separated; and, as it is opposed to both the palæontological and stratigraphical evidence, it must be discarded.

Mr. Park tries to get over the difficulty by supposing that what I have called the Waipara fauna is, in the northern Kaipara district, at Pahi and Paparoa, really an older fauna similar to that of the Amuri series, below the Waipara series, and that the unconformity is really between the Amuri and Waipara series. But is it so? The *Inoceramus* and other forms found at Paparoa are said to be confined to the horizon of the "black grit" at Amuri Bluff, and Sir James Hector places the "black grit" at the base of the Waipara series, and not in the Amuri series ("Outlines of the Geology of New Zealand," 1886, p. 59). It is true that in 1874 Sir James placed the "black grit" at the top of his Amuri series (No. VII.), but in the new classification of 1877–78 he altered its position, and made it the lowest marine bed of his Cretaceo-tertiary series (No. VI.), where it has remained ever since (see Appendix to "Rep. Geol. Exp.," 1887–88). Again, an *Inoceramus*, also found in the "black grit," occurs in the upper Waitangi, with saurian teeth, *Belemnites*, &c., which, according to Mr. McKay, are identical with species at Amuri Bluff not more than 100ft. below the Amuri limestone, as well as at Shag Point, and these cannot well belong to the Amuri series. Besides, if the *Inoceramus* beds in the Kaipara do represent the Amuri series none of the difficulties as to the relations between the Waipara and Oamaru faunas are removed; and, as Mr. McKay points out, the real difficulty is to explain the presence of a "Tertiary-looking fauna" under the [supposed] Amuri limestone. Neither can it prove an unconformity between the Waipara and Amuri series unless the Oamaru series at Pahi can be shown to represent the Waipara series, for in an unconformity it is the upper part of the lower series, and not the lower part of the upper series, that has been removed by denudation, and the missing Waipara series would be classed with the underlying, not with the overlying rocks.

Next, as to the explanations offered by the Survey of this supposed palæontological anomaly of two distinct faunas belonging to the same period, and inhabiting the same geographical area: On this subject Sir James Hector says, "It thus appears from the foregoing that the land-surface preceding the great depression during Cretaceo-tertiary times survived to a later date in the north than in the south of New Zealand, the beds overlying the coals in the north being generally of younger Cretaceous age" (*l.c.*, p. 62). From this I infer that he considers the Oamaru series, with its coals, to be younger than the Waipara series, with its coals. So far, of course, I agree, as it is directly opposed to the idea that the hydraulic limestone is the same as the Amuri limestone, and as it supposes that where the hydraulic limestone lies directly on the Waipara series (as in the Waitangi Valley) the whole of the lower part of the Oamaru series is absent. This explanation of the Director agrees with mine; but when Sir James Hector says that both these series belong to one period I can no longer follow him. The difference between the Waipara and Oamaru faunas is probably as great as, if not greater than, the difference between the Oamaru fauna and that of the present day, and the two could hardly be kept in one formation even if it were certain that they formed an unbroken stratigraphical sequence. But if this were the case we should expect to find in the beds now upraised a gradation from one fauna into the other; for, even if we suppose the Oamaru fauna to have been suddenly introduced by immigration, still it must have mingled with the older fauna before replacing it. This is well shown in the Pareora (Miocene) fauna, the older and younger portions of which differ much; but the species are so intermingled in the middle portion that no palæontological break occurs. The acknowledged existence of a great palæontological break between the Waipara and Oamaru faunas seems to me to imply, although it does not necessitate, a stratigraphical break also, and I have elsewhere said that I think there is evidence of this. The fact of the Waipara series covering so small an area in comparison with the Oamaru series, although the former occurs far up the valleys of the Waimakariri, Waipara, and Clarence, is very suggestive of extensive denudation before the deposition of the Oamaru series, while the relative positions of the two series show that it is not a mere case of overlap. Again, it is not only the coal in the north which is covered by the younger series—the same is seen near Nelson and in Otago; and the discovery of the Waipara series at the Bay of Islands and Hokianga has made some modification of this theory necessary.

According to Mr. Park, an attempt is made to explain the

palæontological difficulty by supposing that the two faunas are of the same age, but that the Oamaru fauna represents the shallow seas, and the Waipara fauna the deep seas. But he adds, "How far this theory will meet the stratigraphical and palæontological difficulties of the case, considering that both of these beds are found to exist in the same areas, I do not propose to discuss in this report" ("Rep. Geol. Exp.," 1887–88, p. 23). With reference to this theory I may remark that if it were the true explanation the terrestrial or shallow-water coal-beds ought always to be followed by the Oamaru fauna, and this by the Waipara fauna, which is never the case. On the contrary, the coals at the Waipara are followed by the Waipara fauna, and this by the Oamaru fauna. If we reverse the case, and suppose the Oamaru fauna to be that of the deep sea, we are no better off, for it succeeds the coal at Kawakawa, Whangarei, and other places without the intervention of the supposed shallow-water Waipara fauna. Also, if the two were contemporaneous we ought surely to find them mixed somewhere. They could not have been separated by a broad belt of uninhabited sea-bottom; nor by a land-barrier, for they are both found on the same side of mountains which were in existence before the faunas. Again, as both faunas occur in glauconitic greensands, &c., we cannot suppose that there was any great difference in the depth of the seas in which they lived; and this is confirmed by the occurrence of both faunas high up in valleys denuded out of Palæozoic and old Mesozoic rocks, which, as they now form high mountains, must at the time have formed neighbouring shore-lines.

But the palæontological difficulties do not end here. At Waihao Forks, in South Canterbury, the coal is overlain by greensands, which contain a third fauna, quite distinct from the other two, and which is admitted by the officers of the Geological Survey to be closely related to the Pareora (Miocene) fauna. A list of this Waihao fauna, which I think to be identical with the Pareora fauna, will be found in the "Trans. N.Z. Inst.," vol. xix., p. 431, and more fully in "Proc. Lin. Soc. N.S. Wales," series 2, vol. i., p. 205. It includes *Aturia ziczac*, two species of *Ancillaria*, and *Pecten hochstetteri*, which is found in both the Oamaru and Pareora series. I do not know to what zone of depth the Survey relegates this fauna: but, as it is found in sandy beds, like the others, the difference can hardly be due to station; and, as it is also found over the coal in the Mokau Valley ("Rep. Geol. Exp.," 1886–87, p. 46), it cannot be due to locality. I have heard it vaguely suggested that the Pareora (Miocene) fauna is a recurrence of the more ancient Waihao (Cretaceous) fauna, similar to Barrande's Colonies, previously mentioned. This hypothesis

accounts for none of the difficulties connected with the idea of three different faunas—of Cretaceous, Eocene, and Miocene facies—belonging to the same period, but living isolated in the same geographical area; while it introduces new difficulties of its own making. For this recurrence necessitates an emigration to some unknown land and a subsequent immigration of the fauna which is very difficult to explain, more especially as the explanation must show why the other two contemporaneous faunas did not accomplish a similar feat.

Mr. Park says, "All that now remains to place the Cretaceo-tertiary on a sound basis is to prove that the characteristic fauna of the Waihao-greensands horizon occurs below the Amuri limestone, as until this is done there will always remain a doubt as to whether the Waihao and Waipara greensands represent two distinct formations" ("Rep. Geol. Exp.," 1887–88, p. 34). On this I may remark that in my opinion the Waihao fauna has already been found in the Waipara district, in the Mount Brown beds and their equivalents, which lie above the Oamaru series, and therefore far above the Amuri limestone. A list of these fossils will be found in "Trans. N.Z. Inst.," vol. xx., p. 261. It is true that the actual species recorded from the Mount Brown limestones and the Waihao greensands differ much; but in other localities all the forms are intermingled, and the great difference in the mineralogical composition of the rocks at the two localities will probably account for the difference in the species.

To sum up: the palæontological objections to the views held by the Geological Survey appear to be insurmountable and impossible to explain. Practically, the Survey gets over these difficulties by ignoring them and classing in one formation all the coals, with most of the greensands and limestones, found in the colony. Its opinion is therefore founded on mineral composition; but the stratigraphical evidence is also said to be favourable, while the palæontological evidence is supposed to be delusive. Because in many cases the coal is covered by greensands, and these by limestones, it is supposed that all must be equivalents. But this is a sequence of common occurrence in many parts of the world, and is due to the recurrence of similar conditions—that is, to subsidence causing estuarine to be followed by shallow-water, and these by deeper-water, deposits. It is therefore of hardly any weight in correlating detached series of rocks. But in our case the officers of the Survey have confounded together two different kinds of greensands with very different origins. The greensands at the Waipara (with the Waipara fauna) and those at Curiosity Shop, &c. (with the Oamaru fauna), are glauconitic greensands; but those at Waihao Forks and Hampden (with the Waihao fauna) are volcanic sands—that is, sands derived

from the denudation of volcanic rocks—and owe their green colour to part of the pyroxene having been changed into chlorite. In these cases, therefore, the beds have been correlated by mere superficial colouring, although it is opposed to the palæontological evidence, and, as I think, to the stratigraphical evidence also.

If, now, we dismiss the lithological and accept the palæontological evidence, all palæontological difficulties, of course, vanish, and it merely remains to be seen whether there are any insurmountable stratigraphical difficulties opposed to the view that the three faunas, with their coals, belong to three distinct formations. This question I have discussed in other papers,* and need not again repeat my arguments. I hold that the stratigraphical evidence either agrees with the palæontological evidence or in some places is neutral, and that it is never actually opposed to it. But stratigraphical evidence depends so much on inference that there is often room for more than one opinion, and arguments are interminable. So far as the Kaipara district is concerned, if Sir James Hector, Mr. Cox, and Mr. Park are right the stratigraphical confirms the palæontological evidence; and if Mr. McKay is right it is neutral. Conformity between two series belonging to different periods is not a great nor an unprecedented difficulty. The Cretaceous appears to be conformable to the Jurassic in many parts of England, although really unconformable. The Carboniferous is sometimes conformable, sometimes unconformable, to the Devonian in England and Wales, while in Scotland and Ireland there is an unconformity in the middle of the Devonian. The Silurian is conformable to the Ordovician in Scotland, but unconformable in Wales and Ireland. The Ordovician is conformable to the Cambrian in Wales, but unconformable in Ireland and Scotland. These examples are sufficient to show that in our case there are no great difficulties in the stratigraphical evidence. Nowhere is the Waipara fauna superposed on the Oamaru fauna. Nowhere is the Oamaru fauna actually superposed on the Waihao fauna, although Mr. McKay *infers* that such is the case at Waihao and in the Waireka Valley.

It seems to me, therefore, evident that the palæontological evidence can be trusted, and that we have in New Zealand at least three distinct coal-formations, characterized by different faunas. How much these faunas have in common, and, consequently, what are the differences in age between them, is another question which has yet to be determined. The correla-

* "Trans. N.Z. Inst.," vol. iii., p. 244; "Rep. Geol. Exp.," 1872–73, p. 44; "Geology of Otago," 1875, p. 50; "Quar. Jour. Geol. Soc. of London," vol. xli., pp. 207, 226, and 279; "Trans. N.Z. Inst.," vol. xvii., p. 307; vol. xix., pp. 406 and 415; vol. xx., pp. 257, 264, and 267.

tion of these three formations with their European equivalents is a third and quite distinct question, and one far more difficult to settle than either of the other two. Of these three coal-formations the coalfields of Shag Point, Whangarei, and Waihao may be taken as representatives. It still remains to ask, are the Grey and Buller coalfields the equivalents of either of them? This question is difficult to answer, because no marine fauna of any extent is as yet known to be associated with the coal-measures, an undescribed species of *Cardium*, called *C. brunneri*, and an echinoderm called *Kleinia disjuncta*, Hutton, being the only fossils known to me. The fossil flora has been examined by Baron von Ettingshausen, who pronounces it to be different from and older than that from the Waipara and Shag Point, being, he thinks, of Cretaceous age. On the other hand, the Oamaru series lies over these coal-measures, probably unconformably, without the intervention of any rocks with the Waipara fauna or flora. This is at present the only evidence available, and, although the palæontological evidence is the more important, it is not sufficient to form any decided opinion upon.

In my opinion the New Zealand coalfields may be grouped by age as follows:—

4. Coalfields belonging to the Pareora series: (*a*) Mokau; (*b*) Waihao; (*c*) Waitaki; (*d*) Pomahaka; (*e*) Dunstan (?).

3. Coalfields belonging to the Oamaru series: (*a*) Bay of Islands; (*b*) Whangarei; (*c*) Drury and Lower Waikato; (*d*) Nelson and Motupipi; (*e*) Kakahu; (*f*) Green Island and Saddle Hill; (*g*) Tokomairiro and Kaitangata; (*h*) Nightcaps, Moreley Creek, and Linton; (*i*) Orepuki.

2. Coalfields belonging to the Waipara series: (*a*) Malvern Hills; (*b*) Mount Somers; (*c*) Shag Point; (*d*) Mount Hamilton.

1. Coalfields belonging to the Amuri series (?): (*a*) Pakawau; (*b*) Wangapeka; (*c*) Westport; (*d*) Greymouth; (*e*) Reefton.

ART. XLV.—*Note on the Geology of the Country about Lyell.*

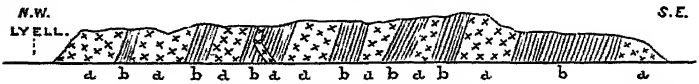
By Professor F. W. HUTTON, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 6th June, 1889.*]

FROM the first geological map of the Provincial District of Nelson (1864), published in the "Geology" of "The Voyage of the 'Novara'," from observations made by the late Sir Julius von Haast, up to the last (1886), issued by the Geological Survey

of New Zealand, the rocks in the neighbourhood of Lyell are shown as foliated schists and granite belonging to the oldest rock-systems of New Zealand, and forming part of a continuous band of those rocks extending from Separation Point down to and beyond the Teremakau River. Mr. A. McKay, however, in his report on the Reefton district,* mentions incidentally that the rocks seen in the gorge of the Buller at and above Lyell are schistose rocks of unknown age, the principal part of which he believes to be Silurian, "although it is more than possible that much younger rocks are present." I was therefore surprised, when I visited that district in January, 1887, to find it formed of sandstones and slates similar to those which have for several years been considered as belonging to the Maitai system, largely injected with granite, which has altered the slates for some distance into cornubianite, but without any foliated schists at all. In fact, so far as I could see, the Buller River nowhere, from its source to its mouth, runs through true foliated schists, but only through these slates and sandstones pierced by granite, or through still younger sedimentary rocks. This discovery makes a great change in our ideas of the geology of this part of New Zealand, for it destroys the supposed continuity between the foliated schists of Westland and those of Nelson.

To enter into more detail: Both sides of the valley of the Lyell River are composed of sandstones and silky slates like those of Reefton, and it is in these rocks that the United Alpine Gold-mine is situated. Boulders of granite are found in the river-bed, but I did not see it in position. Neither did I see the large block of Cretaceo-tertiary rocks shown in the Geological Survey map (1886) on the left bank of the river. A little below the bridge on the Nelson and Reefton Road a well-marked dyke of granite, 2ft. to 3½ft. thick, crosses the Lyell. It can be seen in the cuttings on both sides of the river, traversing slates and sandstones. At the south-eastern end of the town there is a large mass of granite, and between here and the first creek on the Nelson Road—a distance of about a mile and a half—seven bands of altered slate alternate with granite (see cut), the third slate-band from Lyell con-



Section on the road east of Lyell. Distance about one and a half miles. *a*. Granite. *b*. Cornubianite.

taining a dyke of granite 2ft. thick. Beyond the first creek we again find granite, then altered slate, and again granite

* "Reports of Geological Explorations," 1882, p. 101.

crossed by a dyke of hornblende dolerite. About three miles from Lyell we come upon unaltered Maitai slates, followed at five miles by pink and white granites.

When a junction between the granite and slates can be well seen it is always sharply defined, and the granite is generally altered for from 1in. to 6in. in depth into a finer-grained rock, with little visible mica. The altered slate is highly micaceous, and is sometimes reddened for a foot or so from the granite. The evidence is therefore conclusive that the granite is eruptive.

The *granite* is a rather coarse-grained rock, with white felspar and both muscovite and biotite in about equal quantities, and abundant. Its specific gravity is about 2·64. Under the microscope, with polarized light, the quartz shows as a rather fine granular mosaic ("granulitic" of Michel-Lévy), with larger pieces scattered about. Gas- and liquid-cavities are present as usual, and the larger pieces have delicate pale-green hairs of an undetermined mineral running through them rather abundantly, as well as small prisms of apatite. The felspar appears to be all orthoclase, often showing cross-hatching due to the presence of microcline. The muscovite and biotite show their usual characters in convergent polarized light. Iron-oxides are very scarce. The granite boulders in Lyell River differ from that in the road-cutting in containing plagioclase and in having less muscovite, but the quartz is the same in both.

The *altered granite*, near the contact with slate, is fine-grained and brownish-white, with the mica not conspicuous. Specific gravity, 2·67 to 2·78. Polarized light shows the quartz in much finer grains than in the unaltered granite, but it still exhibits the peculiarity of two sizes. Muscovite is present in small crystals, and is rather abundant, but biotite is absent or rare. Felspar is not recognizable as crystals, but forms a kind of ground-mass of a greyish colour, with bright points of quartz scattered through it, thus approaching an elvanite.

Higher up the Buller the main mass of granite agrees with the boulders in the Lyell River, so that it would seem that the main mass is a plagioclase-biotite granite, but that towards the western margin the potash minerals, muscovite and orthoclase, are developed at the expense of the soda-lime and magnesia minerals, plagioclase and biotite.

The *hornblende dolerite* is a dyke in the granite about two miles from Lyell on the Nelson Road. It is very tough and difficult to break so as to get unweathered specimens; compact, black, showing a ground-mass with irregular crystals of augite and altered olivine. Specific gravity, 3·04. The microscope shows an almost holocrystalline ground-mass, some-

times clouded with chloritic granules. This ground-mass is composed chiefly of felspar laths, augite, and small crystals of brown hornblende, with some magnetite. In it are a number of colourless needles, probably of tremolite, often arranged in bundles, and which penetrate the felspar laths. The hornblende is in six-sided prisms, strongly pleochroic, and showing prismatic cleavage. It is mixed with small crystals of pink augite and the other materials of the ground-mass. The porphyritic minerals are augite and olivine. The augite is in large pale-pink crystals, which are nearly colourless in the interior, but with a broad pink external zone. A very good section parallel with the clino-pinacoid gave the angle $c : \gamma$ at 38°. The olivine is also idiomorphic, and occasionally quite fresh, and then pinkish-olive in colour; but usually it is completely changed into serpentine, although easily recognized by its characteristic method of decomposition.

The *slates* of the district are of the ordinary type, common on the west coast of New Zealand, and require no special description. They are more or less arenaceous, and sometimes slightly fissile, but never show true cleavage; consequently they would be called mudstones by some geologists and argillite by others. The specific gravity is about 2·66. In colour they are slaty-blue or greenish. I saw no red or purple slates.

The *cornubianites* are very interesting and are well displayed near Lyell. I recognize two kinds: the second is either the same as the first but less altered, or perhaps it was originally a more arenaceous variety:—

(1.) A fine-grained, dark-grey, tough rock, sparkling on a fresh fracture, and showing mica and quartz. A subfoliation is sometimes developed, but more often it is absent. It never resembles a mica-schist. The specific gravity is 2·76. A thin slice shows quartz in small grains, but occasionally in larger pieces, and then apparently filling up vacuities. Both biotite and muscovite are plentiful; usually the biotite is the more abundant. There is no felspar.

(2.) Fine-grained, greenish-grey, sparkling on fracture, but the mineral components not so conspicuous as in the last. Thin slices show abundant fine quartz-grains, with scattered crystals of muscovite, but no biotite nor felspar. Its specific gravity is 2·71.

ART. XLVI.—*On the Conformable Relations of the different Members of the Waitemata Series.*

By JAMES PARK, F.G.S., Lecturer, Thames School of Mines.

[*Read before the Auckland Institute, 14th October, 1889.*]

Plate XXX.

THE beds forming the cliffs on the shores of the Waitemata generally occupy a more or less horizontal position, but at a few places they have been subjected to great local disturbances, often resulting in sharp contortions and faulting. Strangely enough, these disturbances have in many instances occurred at what may be termed critical points from a geological standpoint, and have thus caused obscurities which have led to much discussion and controversy, not only as to the age of the beds themselves, but also as to the relations which the different beds bear to each other.

The covering of Pleistocene lavas and scoria on the isthmus, and the numerous small bays or inlets which diversify the shores of the harbour, have rendered it difficult, if not quite impossible, to trace particular beds from place to place, while the absence of well-marked fossiliferous horizons has always been an obstacle to the safe correlation of distant beds of the series.

The Waitematas, with perhaps the exception of the Parnell grit or ash-bed, contain no beds possessing mineral characters sufficient to constitute chronological landmarks in the geological succession that would enable the field-work to confidently affirm that certain beds in one locality were the horizontal equivalents of other distant beds—as, for example, that the Fort Britomart beds were the same as the beds at the head of Hobson's Bay, or the North Shore beds the same as the beds north of Whangaparaoa Peninsula. The whole series consists chiefly of frequent alternations of blue clays and soft sandstones, sometimes succeeding each other rapidly as thin-bedded strata, sometimes as heavy bands varying from 2ft. to 10ft. in thickness.

The Fort Britomart beds, which may be taken as characteristic of the greater part of the series, consist of thin layers of blue crumbling clays alternating with layers of soft brownish-coloured sandstones. The clays vary from a few inches to a foot in thickness, and the sandstones from a few inches to 3ft. Fragments of carbonized wood, often laid in continuous layers, are not uncommon in the sandstone bands; and it is a noticeable feature that where the coaly matter is

abundant the adjoining beds are covered with an efflorescence of sulphur.

About 10ft. from the foot of the cliff there is a very characteristic band of gritty sandstone, speckled pretty evenly with small fragments of grey clay. This, or a similar bed, is seen at the top of the cliffs leading round the point from Mechanics' Bay to St. George's Bay, and again near the top of the cliffs behind the Calliope Dock.

The character of the sediments, together with their fossil contents, leave little room for doubt that the beds composing the Waitemata series are mostly of estuarine origin; while the marine forms in the Motutapu beds and Parnell grit, and in the calcareous cornstones at Orakei Bay, St. George's Bay, and Onehunga, point to several periods during which the conditions of deposition were truly marine.

Around Auckland there is no stratigraphical evidence to fix the age of this series. On the isthmus, and at the North Shore, they are overlain unconformably by stratified tuffs, solid lava-flows, and scoria-beds of probably Post-pliocene age; while at Motutapu Island they rest on, or, rather, lap on to, a highly-denuded rocky surface of the basement-rock of the district, of Palæozoic age, consisting of indurated sandstones and slaty shales.

The late Dr. von Hochstetter, in his lecture to the Auckland Institute, 24th June, 1859, speaking of these beds, says, "The horizontal beds of sandstone and marls which form the cliffs of the Waitemata, and extend in a northerly direction to Kawau, belong to a newer Tertiary formation, and, instead of coal, have only thin layers of lignite. A characteristic feature of this *Auckland Tertiary formation* is the existence of beds of volcanic ashes, which are here and there interstratified with the ordinary Tertiary layers."* Subsequently he places the Waitemata series with the Aotea series, both being considered as Older Miocene.†

Professor Hutton, in a paper read before the Auckland Institute in 1870, showed that this series could be traced eastward beyond Tamaki and Howick to Turanga Creek, where, he says, "it rests unconformably on a dark-green or bluish sandstone, generally showing a concretionary structure." ‡

In 1879 Mr. S. H. Cox, late Assistant Geologist, examined the country from Auckland northward to Cape Rodney and the Kaipara. During this survey I accompanied him as his assistant, and at Komiti Peninsula, opposite Batley, we made

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* "Geology of New Zealand," Hochstetter, 1864, p. 26.
† "Reise der 'Novara:' Geology," i., p. 34.
‡ "Trans. N.Z. Inst.," vol. xvii., p. 307.

a large collection of marine fossils from certain blue sandy marls and marly greensands which rest on the denuded and upturned edges of the "Chalk-marls." On examination at the Colonial Museum these fossils were found to include numerous Lower Miocene forms, together with *Pecten zittelli*, Hutton, *Pecten fischeri*, Zittel, and many corals and *Foraminifera* which also occurred in the Orakei Bay beds.*

For this reason Mr. Cox in his report correlates the Komiti beds with the Orakei Bay beds, which he thought should now be regarded as Lower Miocene. Sir James Hector, in his progress report for the same year, dissents from this view, and considers that the Waitematas should be divided at the Parnell grit, all the beds below this horizon, including the Orakei Bay beds, being still retained as belonging to the Grey Marls series of the Cretaceo-tertiary formation.

In 1880, and again in 1881, Mr. Cox re-examined this point, and on both occasions reported that he was fully convinced of the correctness of his former work, although he now considered it possible that the Waitemata series might be of Eocene age.† On the latter occasion he followed these beds eastward to the Maraetai Range, and at Turanga Creek found them resting unconformably, as he thought, upon a concretionary tufaceous sandstone, thus agreeing with Professor Hutton, who had previously examined and described this line of section.‡

In October, 1883, Mr. A. McKay, F.G.S., Assistant Geologist, examined the Orakei Bay section, and the coastline from Lake Takapuna northward to Wade. In his report he considers the Fort Britomart beds the horizontal equivalents of the Orakei Bay beds, and in his section showing the general structure of the country from Wade to Auckland he shows the Parnell grit and associated beds resting highly unconformably on the Orakei Bay beds at Hobson's Bay, and on the hydraulic limestone at Wade.§

He also correlates the Takapuna breccia with the Parnell grit and the Cape Rodney slaty breccia—with the former on stratigraphical, and the latter on palæontological grounds; and concludes his report by stating that he supports Dr. Hector's conclusion that the Waitematas should be divided at the Parnell grit, the lithological characters of which he thinks must mark an unconformity or stratigraphical break.

Professor Hutton, on the 27th November, 1884, read a paper before the Philosophical Institute of Canterbury "On the Age of the Orakei Bay Beds, near Auckland," in which he

* "Geological Reports," 1879–80, p. 37.

† "Geological Reports," 1881, pp. 28 and 95.

‡ "Trans. N.Z. Inst.," vol. iii., p. 244.

§ "Geological Reports," 1883–84, p. 103.

reviews the whole history of the Waitemata beds from the time of Hochstetter up to that date. He criticizes Mr. McKay's work at some length, and disposes of the supposed unconformity at the Parnell grit. He also shows that no evidence had been adduced to prove that the Parnell grit was superior to the Orakei Bay beds, or that the latter were the horizontal equivalents of the Fort Britomart beds.*

In the beginning of 1885 I was directed to revise Mr. Cox's work around Auckland and at the Kaipara, and commenced by making a detailed examination of the fine natural section exposed on the coast from Auckland to the Maraetai Range. Previous to this date fossils had only been found at Orakei Bay and Lake Takapuna; but during the progress of this survey I succeeded in discovering eleven new localities, where exhaustive collections were made, and from the facts disclosed by these, and a large amount of new stratigraphical evidence, I arrived at the following conclusions:—

1. That the Manukau volcanic breccias and tuffs are unconformable to the Waitemata series.

2. That the Parnell grits are under the Fort Britomart beds.

3. That the Parnell grits are the equivalents of the Takapuna breccias and grits.

4. That the Orakei Bay beds are equivalent to the Turanga greensands.

5. That the Turanga greensands are equivalent to the concretionary sandstone at Tamahua, near Cape Rodney.

6. That there is a direct sequence from the Fort Britomart beds to the Papakura limestone.

7. That the Papakura limestone is the base of the Waitemata series, and equivalent to the Cape Rodney calcareous slate-grit.

8. That the Waitemata series is unconformable to the chalk-marls and coal-measures.†

I will briefly refer to the above points in detail.

1. With regard to the Manukau breccias, I am now inclined to think that I was wrong in separating them from the Waitemata series, my work at Komiti Point in 1886 tending to show that they originated during submarine volcanic outbursts of an intense character, some time during the deposition of the Orakei Bay beds, most probably at the horizon of the Parnell grit and Takapuna ash-bed. At Komiti Peninsula, and further north, on the Wairoa, marine beds, containing the characteristic fossils of the Orakei Bay horizon, are interbedded with heavy deposits of volcanic breccias, tufas, and agglo-

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* "Trans. N.Z. Inst.," vol. xvii., p. 313.

† "Geological Reports," 1885, p. 158.

merates, and occasionally sheets of solid lava, consisting of dolerites rich in olivine, hornblende, and augite-andesites. These can be traced southward to the Hoteo and Kaukapakapa, and an examination of the bush country south of the latter will probably show that they are connected with the breccias of the Waitakerei Range and Manukau Heads. The fossils in the Komiti beds indicate a range from the Awamoa series to the Grey Marls series,* which would thus fix the period of volcanic activity in the Kaipara district somewhere about the horizon of the Hutchinson Quarry beds at Oamaru, the deposition of which was attended by violent volcanic displays.

2. In his paper on the age of the Orakei Bay beds† Professor Hutton states that the Parnell grit either passes below the Fort Britomart beds or thins out in that direction. In 1885 I showed in the report already referred to that at dead low water it can be seen distinctly passing below the Mechanics' Bay beds, and, as its inferior position has now been admitted, nothing more remains to be said except to point out that if the Fort Britomart beds are the equivalents of the Orakei Bay beds, as maintained by Mr. McKay, then it follows that the Parnell grit must also underlie the latter, as it has been proved to pass below the former.

3. With regard to this point, I shall have something to say later on.

4. In 1885 I obtained sufficient evidence at Howick and Turanga Creek to clearly demonstrate that there was complete conformity between the Waitematas and concretionary greensand. I showed that the stratigraphical break contended for by Professor Hutton and Mr. Cox at Turanga Creek was only apparent, resulting from the peculiar contours produced by the unequal erosion of hard and soft strata, this view being supported by the discovery of *Pecten zittelli* and *Pecten fischeri* and other Orakei Bay fossils in the concretionary sandstone.‡

5. No fresh evidence has yet been discovered to lead me in any way to modify this conclusion.

6. This point will be dealt with later on.

7. With regard to this, it should be observed that on the slopes of the Maraetai Range the Papakura limestone rests hard upon the old rocks. It does not, however, by any means follow that conformably lower beds may not be developed towards Hunua and Papakura, and I believe it quite possible that detailed survey in that direction may show that the

* "Geological Reports," 1886–87, p. 228.
† "Trans. N.Z. Inst.," vol. xvii., p. 311.
‡ Geological Reports, 1885–86, p. 151.

Papakura beds rest conformably on the brown-coal measures.

8. The unconformity between the Waitematas and the hydraulic limestone at the Wade has been pointed out both by Mr. McKay and myself.*

In 1885 I contended for an unconformity between the Waitematas and the brown-coal measures, not because I had any stratigraphical evidence to prove this, but only on account of the conformable relations supposed by the Geological Survey to exist between the brown-coal measures and the chalk-marls, which I had shown to be unconformably overlain by the Waitematas. The unconformity I placed at this point was only a conditional one.

In his progress report for 1885 Sir James Hector dissents from my view that the Parnell grit is the horizontal equivalent of the Takapuna breccia, which he considers of Pliocene age and quite unconformable to the Waitemata series.† In support of this he shows two views of a section on the coast north of Lake Takapuna, which he believes favours his unconformity. It should, however, be pointed out that wherever the strata occupy a horizontal or undulating position the breccia is seen to be interbedded with and quite conformable to the adjacent beds, and at its base is frequently more or less false-bedded with the underlying clays and sandstones. On the other hand, at points of severe local disturbance, where the breccia is present, the softer and more yielding clays and soft sandstones have in many instances been crushed and contorted and often turned over the more compact, heavy, and unyielding ash-bed, thus giving rise to apparent unconformity.

Sir James advances a rather curious theory for the origin of this fossiliferous breccia. He supposes that it accumulated in great pot-holes during volcanic eruptions in Pliocene times. It would be interesting to know what formed these holes, also what geological agencies were in operation at that time to limit the distribution of the breccia and its imbedded life to these repositories.

As a matter of fact the breccia has a linear extension of many miles, extending from the Waitemata to Whangaparaoa Peninsula, and varying in thickness from 10ft. to 20ft. As to its age, it contains *Terebratella dorsata*, *Pecten polymorphoides*, *Celleporina*, and many net and branching corals and cup-shaped *Bryozoa*, which led Mr. McKay to correlate it with the slaty breccia at Cape Rodney, which has always been considered as Lower Miocene.‡

* "Geological Reports," 1883–84, p. 103; 1885–86, p. 162.
† "Geological Reports," 1885–86, p. xxxviii.
‡ "Geological Reports," 1883–84, p. 101.

In January of 1888 Mr. McKay was directed to examine the principal sections around Auckland and at Howick, on which I had based my conclusions in 1885. He agrees with me on all the main stratigraphic points, and now admits that the Parnell grit passes below the Fort Britomart beds.* He is also agreeable to my correlation of the Fort Britomart and Calliope Dock beds, the latter of which he thinks must also be underlain by the Parnell grit.

Speaking of the Cheltenham Beach breccia, he says it dips to the eastward, and must therefore pass over and be superior to the Calliope Dock beds, which dip N.E. or N. at a very low angle; and in consequence of this he renounces his former opinion that the Parnell grit is the southern extension of the Cheltenham breccia, his reason for adopting this new view being based on his admission that the Parnell grit passes below the Fort Britomart. In his own words, he states, "As a consequence of my admission that the Parnell grit does or should pass under the Fort Britomart and Calliope Dock beds, and of the observed fact that the breccias north of Cheltenham Beach overlie there, I am forced to agree with Sir James Hector that the Parnell grit and the Cheltenham Beach and Takapuna breccias do not occupy the same horizon, and that the Parnell grit is the older deposit."†

On the 29th August last I examined the line of section between Cheltenham Beach and the Calliope Dock, believing that the stratigraphical evidence relied on by Mr. McKay was not sufficient to prove that the fossiliferous breccia at the former place passed over the almost horizontal strata at the latter.

At Cheltenham Beach the dip of the strata forming the cliffs at the north end of the sandy beach is to the east or seaward at an angle of 35°, as ascertained by myself in 1885, and subsequently by Mr. McKay in 1888. The cross-section of the end of the cliff is illustrated by the annexed sketch (Plate XXX., fig. 1), where—

1 is blue clays;
2, bed of coarse grit, showing false bedding at base;
3, bed of brown sandstone speckled with white grits (pass insensibly upward into the overlying bed);
4, greenish tufaceous grits;
5, soft rusty-coloured sandstone, probably the upper decomposed surface of 4.

Passing northward from the end of the cliffs, the grit-beds (Cheltenham Beach fossiliferous breccia) run parallel with the shore a distance of 10 or 12 chains, beyond which they are

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* "Geological Reports," 1888, p. 40.
† *Ibid.*

followed by a great thickness of banded clays, which form the headland here, where the dip changes to westward. The section along line C–D (Plate XXX., fig. 2) shows the arrangement of the beds at the point as follows:—

1, false-bedded sandstones, blue clays, and grits;
2, tufaceous grit (fossiliferous);
3, banded clays and ferruginous sandstones, alternating as thin layers.

Proceeding along the beach from C (the west end of the section), the dip rapidly increases from 35° to 45°, and then to 60°, and at the extreme point the direction of the dip changes from E. to W. at angles between 45° and 50° (Plate XXX., fig. 3);

1 being blue clays;
2, grits and tufaceous sandstones;
3, banded sandstones and clays;
4, beach-sands;
H, Cheltenham Beach.

At the Calliope Dock the strata are lying almost horizontal, or dip at an angle of 2° or 3° to the northward. From the top of the cliffs behind the dock the surface of the ground slopes rapidly to the northward, and at the road-line to Lake Takapuna is only a foot or two above high-water mark. From this point towards Cheltenham Beach there is a wide stretch of low swamp-land where it is impossible to make stratigraphical observations of any kind whatever. But, besides this break, it is necessary to point out that the foot of Mount Victoria lies almost, if not right, in the line of section, and I think it more than probable that the easterly dip of the beds at Cheltenham Beach is due to the eruption of the lavas and ejecta which compose that hill.

As there seemed to be little prospect of obtaining satisfactory evidence in this direction, the next dây I made a close examination of the Parnell grit at Judge's Bay and Parnell Point, and at the former was fortunate enough to discover a number of marine fossils near the base of the cliff, at the end of the long flat reef which extends from the east side of the bay far into the harbour in the direction of the North Head. They occur mostly in the lower 2ft. of the grit, which is generally more or less calcareous; but they are by no means plentiful, and from their dirty-yellowish colour, which closely resembles that of the matrix, they can rarely be seen without close inspection of the weathered surfaces. They are mostly testiferous, but brittle and fragmentary, and good specimens are scarce.

Among the forms collected were a *Cerithium*, *Pecten polymorphoides*, a *Teredo*, several small corals, and fragments of a

long thin shell which at first I thought might be *Scalpellum aucklandicum*, Hector, of which I made a large collection at Motutapu Island in 1887; but better examples will have to be obtained before this can be definitely determined.

The *Cerithium*, *Pecten*, and corals are the same as those found in the breccia at Cheltenham Beach, thus proving conclusively that the Parnell grit is the southern extension of that stratum, deposited at the same time and under the same geological conditions. It also shows that the Calliope Dock beds, if related to those at Fort Britomart, must be superior to the breccia at Cheltenham Beach and Lake Takapuna.

As bearing upon the relation of the Parnell grit to the Orakei Bay beds, I may mention that during my last visit to St. George's Bay I found a number of Orakei fossils in the flat, irregular, calcareous gritty cornstones at the foot of the cliff on the west side of the bay. These cornstones are only exposed at low water, and occupy a position some 15ft. or 20ft. above the Parnell grit. Their exact position is shown in Plate XXX., fig. 4:—

A. St. George's Bay;
B. Parnell Point;
C. Mechanics' Point;
D. Fossiliferous cornstones;
1. Mechanics' Point beds;
2. Layer of cornstones;
3. Parnell grit.

The fossils collected at point marked D in Plate XXX., fig. 4, were *Pecten fischeri*, *Vaginella*, *Orbitolites*, and a number of small corals.

The occurrence of Orakei Bay fossils in this position would tend to show that the Parnell grit is inferior to the Orakei Bay beds; but, if the evidence is not sufficient to prove this, it shows that these two horizons are at least not far separated from each other.

At the east side of Judge's Bay the Parnell grit rests on an irregular thin layer of blue clay containing minute *Foraminifera*. An examination of these might throw some light on this point.

Art. XLVII.—*A Theory on the Formation of Gold into Specks and Nuggets.*

By H. P. Washbourn.

[*Read before the Nelson Philosophical Society, 16th September, 1889.*]

In this paper I shall open the question, How is gold formed into specks and nuggets? and also dispute the theory that alluvial gold was not derived from reefs, but was formed in the drift in which it is found. This, I consider, is a theory as yet quite unsupported by any facts, as the reasons relied on to establish it are quite untenable.

If the gold were deposited from solution as a dark impalpable powder, how did it get into the quartz in the shape of specks and nuggets, in which it is found? This is a question I have often heard asked, but I have never heard or seen it answered.

In accounting for it, we must quite put aside the idea that the reefs have been molten, and that the gold has been melted into the shapes in which it is found. There has never been a reef found with evidence of its having been formed by molten matter; but, even if there had, it would not account for the way the gold is found in the many reefs that evidently have not been affected by heat. The heat necessary to melt quartz is so great that it would have changed the character of the rock forming the walls of the reef, with which the molten matter must have been in contact; and the other minerals found in the quartz in masses, and crystals containing such volatile substances as sulphur, arsenic, antimony, &c., must have been altered, and the volatile portions driven off by the intense heat.

But the walls only show the action of water, and in the hard quartz we find perfect crystals of minerals that less than a red heat would destroy: yet these are perfect; and the hard quartz surrounding the crystal takes the exact form of it, showing that the quartz was soft when the crystal was formed, though not molten.

Beyond doubt the gold was carried into the reefs in a solution by water, and, meeting with a reagent, was precipitated as a powder, the particles of which were as fine as or finer than anything we can conceive, and this was deposited on and with silica in a soft state. There are several reagents that will precipitate gold from solution, such as sulphate of iron, formed by the decomposition of iron-pyrites, vegetable matter, &c., and I think it very probable that in the same reef the gold has been precipitated by different causes at various parts and

periods of its formation, and that, like most things in nature, a reef, with its minerals, is the result of a combination of many causes, of which, although there are a few we do know, there are a great many we do not know as yet.

The atoms of precipitated gold, having a very strong attraction for each other, would gradually draw together, forming minute specks, which would also be drawn towards each other, forming larger and irregular specks as they joined, until the hardening of the quartz prevented any further movement.

The time taken by quartz in hardening would probably vary in different reefs, and also at different times and places in the same reef. Where the hardening has been slow the gold would be coarse, and, if a flat reef, towards the foot-walls, as its great specific gravity would give it a downward tendency. Where the gold-precipitate was evenly distributed with the silica, and the hardening of the quartz was not very slow, the gold would probably be in fine specks through the stone, as there would only be time for the contiguous atoms to join before the quartz became too hard for further union. We can see by the hot springs in the North Island that when silica has been held in solution in hot water it hardens much more quickly than when the water is cold.

At the Thames and Te Aroha, where the hot springs have evidently played a part in the formation of the reefs, we find the gold in very fine particles; and I suspect that a good deal of the gold (not recognizable as such, and) said to be an ore of gold is really the gold as precipitated, the quartz having hardened too quickly for the atoms to join together to form specks. We must bear in mind that gold is only yellow by reflected light, and that in a state of fine division it is simply a dark powder, and would look like an ore.

It is very common in quartz-specimens to get what is called a nest of gold, which generally consists of one large speck surrounded by a number of smaller ones at various distances from it. These, I believe, are a number of atoms attracted together, gathering and joining other particles as they are drawn towards the centre; and if the quartz had remained soft long enough they would have joined the centre one at different points, forming one large irregular speck. If we consider the great ductility and malleableness of gold, we shall not be surprised at the powerful attraction the particles seem to have for each other, as those qualities are due to the cohesive attraction of the atoms of which it is composed; and if this is so great when near together it does not seem unreasonable to expect that when separated by a short distance the same power should exist, although perhaps in lessened degree according to distance. A certain degree of heat seems to increase this. I have often seen with alluvial gold, when heated a good

deal below red heat and shaken, the specks of gold would adhere firmly together—sufficiently so to remove them from the sand—and then fall apart as they cooled. If the gold formed into specks in the quartz by the attraction of its atoms, so did the pyrites, crystals, &c., by a similar process before the quartz hardened. At the Parapara, ironstone pots or bombs can be seen in all stages of formation, from the first rough outline, enclosing a quantity of iron-containing earth, to the highly metallic shell enclosing the earth from which every particle of iron has been attracted to form the pure-iron-looking bomb.

In his "Chemistry of the Goldfields" Professor Black mentions a theory originating with Mr. Selwyn several years ago; and the question is put in this way: "Do nuggets grow?" Of course, the growing must be understood to mean an increase of size by the addition and cohesion of atoms of gold. In this way I think they undoubtedly do grow; and if a flow of water carrying gold in solution—but not silica—were to pass along a lode under favourable conditions for deposition for a sufficient time they might grow to any size. But, in an ordinary way, the water carrying gold in solution does carry silica with it, which, being deposited and hardened, prevents further union of the gold atoms, thus limiting the size of the nugget and forming a reef. The exceptional ones, carrying gold in solution without much silica (or not depositing it), allow the gold to accumulate in the favourable places for its deposition as excrescences on the walls, or vughs, in the watercourse. Although I agree that nuggets do grow, I do not think there is evidence of their having done so in the drifts or washes, the strongest arguments brought forward in support of the theory only tending to show the possibility of it. The following are the chief arguments used in favour of the theory that alluvial gold has grown in the drifts:—

1. "Nuggets are found in the alluvial drift of larger size than any piece of gold ever got from reefs." In answer to this we must consider the very small amount of quartz reefs that have been broken up and worked by man, as compared with the immense quantity broken up by Nature and forming the drifts. The difference is so immeasurable that the comparison is absurd.

2. "That alluvial gold is of a higher quality than reef-gold from the same neighbourhood." This is said to be a very strong argument, but I consider it requires very careful investigation before it is taken as a fact. I do not admit that the statement is correct as a rule, and I will mention two cases to show why: First, in Bedstead Gully there were two distinct qualities of alluvial gold—one a rough honeycomb gold, derived from the reef at the head of the gully, and of the

same quality; the other a more travelled, much water-worn gold. At the Quartz Ranges, again, a similar thing occurs—the rough gold being of the same quality as the gold in the leaders now being prospected; the other sample showing signs of being more water-worn, and having travelled some distance. Now, if, in either of these cases, the sample to be tested was the travelled one, and it was compared with the reef-gold known in the neighbourhood, it would appear of very different quality. The quality of the gold may vary in reefs even close together; so that it is not surprising in drifts—which may have, and probably have, derived their gold from several sources—to find that the analysis does not coincide with the gold from the only one source known.

3. "There is a nuggety or mammillated appearance about drift-gold which reef-gold does not present." This is quite correct; and it is the result of the bruising and wearing action of the gravel, &c., it has come in contact with in the drift. Take Mahakipawa Creek, for instance: examine the gold in the lower part of the creek, and it is a smooth, solid, water-worn gold; further up it becomes more mammillated and less worn; and as it gets nearer to the source from whence it was derived the mammillations become rougher and sharper, until it appears the sharp-pointed rough gold nearly as it came from its matrix. This would point to the mammillated appearance being caused by a certain amount of attrition on the rough, pointed, matrix gold. The same thing can be seen in other places, but I mention Mahakipawa because, from the coarseness of the gold, it is more easily noticed there.

4. "That nuggets often contain a core or nucleus of oxide of iron." This is no evidence that nuggets were formed in the drift, as the same thing could occur equally well if the nuggets were formed in the rock according to argument 10.

5. "Gold has been repeatedly found in solution in mine-waters by analysis. It has also been found as a golden incrustation in iron boilers fed with mine-waters." If this is any evidence at all, it is in favour of nuggets being formed in the rock, as it proves the necessary gold-solution there, but it does not prove the gold-solution in the drift.

6. "Many fragments of wood lying among the gold-drift *débris* have been found petrified into iron-pyrites, and such pyrites, when analysed, has always yielded gold, generally at the rate of several ounces to the ton." If it were certain that no mine-water had been in contact with them this would seem to be the best and only argument brought forward, as it would tend to show that drift-water may carry gold, and deposit it under favourable conditions.

7. Professor Egleston, of New York, points out "that good gold is often found buried to the depth of 8in. or 10in. in the

bottom or bed-rock, especially where the bed-rock is soft and porous. The gold so found could not by any conceivable process have got there except in solution." In gold-digging this is a very simple every-day experience. If a ground-race for sluicing golden dirt is made across ground that does not contain gold, under the conditions given (a soft porous rock), the fine shotty gold will work down in the rock not only 8in. or 10in., but in many cases more than twice that depth; and the process can be seen. The water penetrates porous places, softening and sometimes removing some of the lighter material they contain, thus allowing the fine round gold to sink; and gold may be obtained as far as this action has gone, but not farther.

8. "That, if the gold in the deep placers had come ready formed from the vein-matter in the reefs, it would be distributed in layers of unequal richness through the bed—the richness depending on the amount of deposition taking place at any one time—and would not occur in increasing richness from top to bottom." Professor Egleston, who points out this argument, has evidently no knowledge of how drifts are formed. In the first place, the layers are of unequal richness, and naturally get poorer and the gold lighter upwards from the bottom. The richness of the layer does not so much depend on the amount of deposition at one time as on the quantity and quality of the *débris* passing over, and from which the deposition has been made. Take the Maitai River, for instance, and suppose the rock it has cut through and washed away to have been gold-bearing down to its present level; then let an obstruction occur at the lower end, causing a layer of gravel to accumulate all up the valley. At this level the river might run for ages, depositing whatever gold and heavy mineral might be washed into it. The accumulations and running-levels might go on indefinitely, but in each succeeding level there would be less gold per ton, and of a lighter description, for these reasons: that the bottom layer would have all the gold contained in the rock washed away in forming the whole length, breadth, and depth of the valley up to the time of the obstruction, concentrated into a narrow strip. Each succeeding layer would cover a much wider area, and, even if it contained the same number of ounces, would be much poorer, as the gold would be dispersed through so much more stuff. Another reason why succeeding levels would not be so good is that only very light gold will travel over gravel; so that, with the creeks and feeders, most of the gold would remain on the bed-rock above the junction with the layer. It is a common thing on diggings for the gullies round a flat to be payable and the flat too poor; and in the case of the Australian deep leads the original bottom levels, containing

the gold concentrated out of an immense extent of country into narrow channels, have been found and followed.

9. "It is on hard bottoms, false or true, over which the drift-water mostly flows, that the washdirt as a rule is richest." This is not borne out by experience. The richest gold is found on the bottom that forms and retains the best mechanical catches with regard to the course of the depositing stream; and where the bottom has any advantage for catching and retaining the gold, there the richest places will be; and, as a rule, these are on the higher portions, where the drift-water would not flow.

10. "The marked quantity of reddish oxide of iron at the level of the richest washdirt is partly accounted for by the oxidizing power of chloride of gold." It may be; but I do not see how this would account for the fact that all minerals of high specific gravity associated with the gold in the rock are found deposited with it in all its situations, and, like the gold, more or less water-worn. To any one experienced in ground-sluicing this is clear enough, as precisely all the action of drift-formation is seen on a small scale, and the phenomena mentioned to show that the gold formed in the drift will invariably take place in it. It is the natural result of force of water acting on material of different specific gravities; and the action is just the same, the only difference being the magnitude of the operations. If gold were found in the drift clearly separated from any of its heavy rock-associates, it would be a stronger argument in favour of its having been formed there than anything that has been brought forward yet.

The question is not, Is it possible under certain conditions for gold to form in a drift? but, Is there any evidence to show that it has done so to any appreciable extent? While admitting that it is quite possible under favourable conditions for gold to have formed in the drifts, I do not think that there is the slightest evidence that it has done so to any noticeable extent. A careful examination of drift-gold under a powerful magnifying-glass would be of assistance in determining the question: for if it formed in the drift it certainly should not have an abraded surface; and this, I think, all drift-gold will be found to have, with the possible exception of a very little that has been released by disintegration of the matrix while in the drift. I believe that nuggets have grown as defined above, but think it has been in the hollow vughy water-channels or lodes in the rock, not in the drift-gravel.

Art. XLVIII.—*Origin of the Loess Deposit of the Timaru Plateau.*

By J. Hardcastle.

[*Read before the Philosophical Institute of Canterbury, 5th September, 1889.*]

So far as I am aware, three varying opinions have been published respecting the origin of the clay, silt, or loess which covers the dolerite sheet in the Timaru plateau.

The late Dr. von Haast ("Geology of Canterbury and Westland," p. 367) adopted Richthofen's theory, that it is a subaerial formation, which has grown up under existing conditions, and is still growing.

Professor Hutton raised some strong objections to that explanation, and ("Trans.," xv., 416) concludes (with special reference to an admittedly similar deposit on the flanks of Banks Peninsula) that "the evidence in favour of the marine origin of this deposit preponderates enormously over the evidence in favour of subaerial origin."

Lastly, Mr. J. Goodall ("Trans.," xix., 457) declares the Timaru loess to be a volcanic ash.

The object of this paper is to state some evidence which proves that the Timaru loess, and presumably also the similar formation on Banks Peninsula, and others elsewhere, is of subaerial origin; that it is a formation of wind-borne dust, entrapped by successive generations of dry-land vegetation; that the whole deposit from base to summit, inch by inch, line by line, film by film, has successively been a dry-land surface; that it accumulated not only slowly, but intermittently, with prolonged periods of pause; and that its growth was dependent upon a set of climatic conditions which no longer prevail in the neighbourhood.

For the production of a massive subaerial formation of dust four factors are required—(1) a source of wind-borne dust, (2) winds to transport the dust, (3) vegetation to entrap it, and (4) sufficient time for its accumulation. In respect of this formation, the first of these factors must be indicated, but need not be located. The second will be granted; also the fourth. The third will be admitted if it is proved that the deposit was formed on dry land. I leave the indicating of the source of dust for the present, proceeding first to prove that the loess is a dry-land formation.

The Material.—The material of the deposit is remarkably homogeneous in character, and is almost wholly fine enough to be easily taken up and transported by winds. The exceptions are a few elements which could not have been wind-

borne, and these—except, here and there, at low levels, scattered pebbles and boulders of scoriaceous dolerite of local origin—are among the evidences in support of the dust-heap theory.

A Buried Water-hole.—Among the numerous excavations made in the loess at Timaru, the most instructive as to the origin of the formation is one made to the southward of the railway-station to form a site for the engine-sheds. The section left by the excavation, say 20ft. deep (all numbers in this paper are rough guesses), shows at the surface the remains of a swampy hollow—one of scores, perhaps hundreds, scattered over the Timaru Downs. Some of these hollows contain pools of water after heavy rains in summer, and continuously through the winter; larger ones are never dry, and contain a growth of peaty vegetation. The hollow cut through by the excavation referred to was of the latter class. It once contained a growth of peat, which had been set on fire in the early days of the settlement, or possibly earlier, by aborigines, and the light ashes now form a layer a few inches thick beneath an ordinary black soil. The clay beneath this old pool is distinctly stained blue by phosphate of iron, through the action of the percolating swamp-water upon the iron contained in the clay. This coloration extends downwards for several feet, and gradually fades out. Rather more than halfway down the face of the cutting the section shows the remains of a similar but smaller water-hole, with a little carbonized vegetable matter lying upon the uppermost of several thin layers of silt which were successively deposited in the hollow, and are marked off by lines of peaty stain; and there is a repetition of the blue phosphatic stain in the clay beneath, the stain extending downwards below the base of the section. In this buried water-hole we have proof positive of the existence of a dry-land surface during its formation and existence. Tracing it outwards, the bed merges insensibly into the general homogeneous mass of the formation, but into a layer of it marked by a character to be described in the next paragraph.

Subsoil Iron-ore Granules.—In every railway-cutting and cliff exposed to rainfall there are to be distinctly seen several bands, 1ft. or 2ft. in depth, curving in the spurs so as to be roughly parallel with the present land-surface. These bands project slightly from the general slope of the cuttings, and are also a little darker in colour. Examination shows that the darker colour of these bands, and their relatively greater power of resisting erosion by rain, are due to the presence of numbers of granules of an oxide of iron—precisely such granules as are to be found in the subsoils of damp lands—numerous and large in the subsoil on the margins of the surface peat-

pools, and very sparsely scattered through the present subsoil elsewhere. Similar granules are to be found scattered thinly throughout the mass of the loess, but they are distinctly numerous in these bands. These granules must have taken some time to form, and other evidence is forthcoming in proof that the layers in which they occur respectively formed a soil and subsoil for very long periods of time. It is to be inferred, too, that the ore-granules indicate the prevalence of a very wet climate during the whole or some portion of each of these periods, as such granules do not appear to be formed except in wet soils. The climates must have been very wet, as the curvature of the granule-bands is such that the land-surface which each represents was well drained. The buried peat-bed already described is easily traced outwards into one of these granule-bands.

Humus-stains.—The vestiges of the successive generations of vegetation have been almost but not wholly obliterated. It would seem that the growth of the deposit was so slow as to nearly allow the rootlets of each generation of plants to suck up the last remnant of the decay of previous ones. Nearly, not quite. Whenever a cutting is newly made, or a fresh face is formed on a sea-cliff, there is observable from top to bottom a brownish stain in the clay, which is intensified a little in certain bands. This stain disappears after a short exposure to the air, the surface soon assuming a bright-yellow "clay" colour. The uppermost of these dark bands, which varies in position from 5ft. to 8ft. or so beneath the present soil (and in some places also the second band, some feet lower down), shows in old "backs," or natural crevices, abundant stains caused by the decay of rootlets, the ramifications of which can be easily traced. This evidence, taken alone, would not be of much value, as recent rootlets—very few in number, however—penetrate these cracks. The obscure brown stains in deeper bands, to which recent rootlets do not extend, are evidently of the same character as the more strongly marked upper ones, and I have no doubt that these darker bands, and the more diffused stain of the spaces between them, are due to a trace of humus remaining in the successive subsoils. The ore-granule bands previously described are the representatives in a weathered face of the bands of darker stain in a fresh face of the clay. Such granules of ore are frequently formed in the present subsoil in the shape of pipes around decaying roots. I have found in the granule-bands specimens which bore on a concave surface plain imprints of vegetable form. At a low level in the deposit there is to be seen here and there a stratum of fine, dense, somewhat plastic clay (as Sir J. von Haast well described it in one of his reports), which, from the positions in which it occurs, can be nothing else than

a fine mud settled from pools of storm-water. This low-lying, exceedingly tough and impervious material has in some places retained stain-impressions of roots.

Worm-borings.—Very satisfactory proof that the loess is a dry-land formation is afforded by the fact that worm-borings are to be found in it plentifully, in the dark bands, from top to bottom. Most of them have been filled up by the worms, as are recent borings; but some are partly open, and the upper part of the filling consists of loose distinguishable "casts." It cannot be asserted that the lower borings were made by worms working down from the present surface. The borings are unmistakably more numerous in and just beneath each brown-stain band than in the spaces just above these bands, and they are in some places to be found beneath, and terminating abruptly at, the mud-beds just described, which have not been bored through at all. There are also to be found in the stratum beneath it worm-holes plugged with this mud, the plugs preserving the characteristic irregularity, the departures from cylindrical form, in the shape of the borings. The "capillary texture" of the loess, mentioned by Sir J. von Haast, is evidently due more to the multitude of worm-borings than to the decay of roots, though this, no doubt, had some influence in producing it.

Evaporation-veins.—Another evidence of the dry-land origin of the loess, and of long pauses in its growth, is the existence, beneath some of the lower granule-bands, of what, for want of a known name, I must call "evaporation-veins." Most clay-formations contain what excavators call "backs"—natural vertical cracks—and these are usually lined with a film of greater or less thickness of finer, whiter, and denser material than the clay between them. In many roadside cuttings these vertical veins are seen to streak the clay quite thickly. If the vegetable soil be cleared away these veins are seen to divide the subsoil into irregular figures, rude pentagons being the most common form. In size the figures vary from a few inches up to 2ft. in longest diameter. A small number may be larger.

I have never met with an explanation of these veinings, and must attempt one. Whenever a soil cracks through drought the cracks extend into the subsoil. The cracks in the subsoil must be fine, as one never finds on digging into it streaks of dark vegetable soil fallen into them. As the drying of the ground in a drought proceeds, the moisture at the surface of the fissures will evaporate; and that remaining in each prism of clay will constantly endeavour, so to speak, to maintain its capillary level, and will keep up the supply for evaporation at the fissures. In thus moving towards the fissures, I conceive that the water drags with it such fine

particles of earth as can be moved between the coarser particles of the mass, and these fine particles are of course deposited on the sides of the fissures when the water evaporates. The fissures, once formed, remain planes of weakness, the ground cracks in the same lines year after year, and in course of time a considerable thickness of fine material may be thus separated from the mass and collected upon the sides of each clay prism. (Is the whiteness of the veins due, wholly or in part, to a bleaching-power in the water which filters into them from the soil when a rain occurs?) In the present subsoil at Timaru these white veins range up to 1½in. in width, between prisms of clay not exceeding 2ft. in longest diameter, and they extend downwards as much as 8ft. or 10ft. in some places. In the lower portion of the loess there are two or more series of these veins, the highest terminating above in a granule-band about 10ft. above the rock. There is another terminated by the second well-marked band from the surface. There may be other series: the cuttings are too much hidden by rain-wash to allow one to see. If there were any possibility of mistaking the veins in vertical sections, there can be no mistaking the characteristic pentagonal forms seen in horizontal sections. The existence of these veins supports the testimony of the granule-bands as to the occurrence of long pauses in the deposition of the loess. But, while the granule-bands seem to indicate a wet climate, the evaporation-veins indicate a dry one, and to accept the contradiction and explain it we must suppose the pause was sufficiently prolonged to permit of a complete change of climate, either from wet to dry, or from dry to wet.

"*Bird-stones.*"—It would be reasonable to suppose that the surface peat-pool cut into by the engine-shed excavation was formerly more or less frequented by water-fowl, and that they would leave lasting vestiges of their visits or sojourn there in the shape of ejected gizzard-stones. As a matter of fact, they have done so. Many small stones, well worn—unquestionable "bird-stones"—can be picked out of the clay immediately beneath the ashes of the burned peat-bed. The same expectation might be formed regarding the buried peat-pool; and it would be fully justified, for these vestiges of the water-fowl of the period are immeasurably more numerous there than similar ones in the surface-hollow. The majority of the stones are small, though larger than those in the upper bed, but among them are some the size of common marbles. Large and small, there must be a bushel or two of gizzard-stones buried with this old water-hole, the section of which is only about 20 yards long, and the stratum representing the pool only 12in. or 15in. thick. The same proofs of the existence of bird-life are to be found throughout the deposit, from the clay

which fills the larger crevices in the dolerite to the top, very thinly scattered through the mass generally, but in astonishing numbers in the granule-bands. In each of at least three of these bands superposed at one spot bird-stones exist in such quantities that one may well speak of them as "so many bushels to the acre." Certainly no farmer could afford to sow grain so thickly. The buried peat-pool runs out into the uppermost and most prolific of these. The majority of stones found in the buried pool are of quartz or of other mineral whose whiteness deceived the birds; those found in the granule-bands, while containing a not-inconsiderable proportion of white stones, are of all colours, but for the most part of hard materials. Water-fowl usually possess considerable powers of flight, and from frequenting watercourses they have a better chance of obtaining quartz or other white or whitish pebbles. This would account for the larger proportion of such pebbles in the buried pool. Land-birds, whether of powerful flight or not, have not the same opportunities for selection; hence the mixed character of the pebbles found in the granule-bands — the old land-surfaces. The whole of the pebbles can, I believe, be matched as to mineral character from the drift-deposit overlain by the dolerite.

Bird-stones are to be found in the present soil and subsoil, but they are so rare that the search for them is disheartening work. This refers to the dry-land surface. In the old peat-pool at the engine-shed very small stones are somewhat numerous, and beneath the mud in the bed of the Waimataitai Lagoon, now being cut back by the sea, white stones, of such size that they must have been used by some of the moa tribe, are not uncommon. In two places—one near the base of the deposit, the other in the lowest granule-band—I obtained a few large, mostly well-rounded pebbles of brown sandstone, such as could only have been used by gigantic birds.*

Moa-bones.— Moa-bones have been obtained from the formation. Some were dug out in making the excavation for the passenger-station, but I cannot say from what position. In the somewhat low sea-cliff of clay at Dashing Rocks moa-bones are occasionally weathered out, about one-third of the way down the face. These have no relation whatever to the remains of a moa-hunters' encampment near that spot, these remains being wholly contained in black soil.

Exceptional Bedding.—The loess generally is quite devoid of stratification in the ordinary sense, but there are small portions here and there which show a perfect bedding. Sir

* This section will suggest a solution of the "very puzzling geological problem" stated by Mr. J. C. Crawford in "Trans.," xvii., p. 341.

J. von Haast mentions one of these in a report on the water-supply of Timaru. A much larger patch was cut into in "stripping" off the clay at the North Mole Quarry, on the bank of the Wai-iti Creek. This patch rises upwards from the creek as though laid down upon a sloping bank; the bank of clay it overlies is well veined and worm-bored. During the formation of a mass such as this from wind-borne dust, it could not but happen that now and then storm-waters would scour away from one place, and deposit in stratified form in another, some of the surface-soil. These rearrangements of material would naturally be made most frequently near the large watercourses, and it is in such positions that the only two cases I am aware of are found. The one mentioned by Sir J. von Haast is in the cliff bounding the Waimataitai Valley, on the south side. It consists of a small patch, as seen in section in the sea-cliff, 10ft. or 12ft. wide, 4ft. or 5ft. deep, and situated about midway up the cliff. The other case, as already stated, is beside the Wai-iti Creek. Granting that this bedded layer was laid down by a flood in the creek, it must appear that the stream had not then cut through the 50ft. of dolerite rock as it has done, and through some 150ft. of the underlying drift-formation besides. The Waimataitai Creek has similarly, but in less degree, cut down its channel since the patch of stratified loess was laid down.*

In dealing with the vestiges of vegetation mention was made of a fine, somewhat plastic clay which occurs here and there, and regarding which it was suggested that it must be a mud deposited by pools of storm-water. This view is suggested by the fact that the best specimens of it are found in hollows in the rock-surface. In the North Mole Quarry a depression in the rock-surface was evidently almost filled by it, the deposit exceeding 2ft. in depth in the centre, and thinning out towards the margin of the hollow. In many places the mud-bed is formed, not at the base, but at some higher and apparently not constant level, yet never far from the base. A hint is supplied by the case of Wai-iti Creek, and the stratified silt at Waimataitai (which rests upon a similar mud), that the cutting-down of the channels after a time prevented the overflowing of storm-waters, and the production of more mud-beds and bedded rearrangements of the silt.

Summary of Evidence.—I think it will be conceded that the evidence herein adduced is sufficient to prove the growth of the Timaru loess as a strictly dry-land—an Æolian—deposit. There are good evidences of several old land-surfaces in

* Since this paper was written it has occurred to me that the Wai-iti Creek patch was more probably a wind-drift. Unfortunately this idea did not occur to me soon enough, for on going to the quarry to re-examine it I found it had been nearly all carted away.

(1) bands of soil and subsoil ore-granules, (2) humus-stains, (3) worm-borings, (4) bird-stones—all in the same bands; (5) a buried water-hole in connection with one of them, (6) series of "evaporation-veins" in connection with more than one, (7) and, lastly, the exceptional occurrence of current-bedding, in silt and mud-beds near watercourses. All these evidences are mutually corroborated, and point to but one conclusion—the conclusion above stated.

Marine, lacustrine, or fluviatile agencies are entirely out of the question. The Timaru plateau stands above all the surrounding country, and on the summit of Mount Horrible the loess rises to over 1,000ft. above the sea. Neither lake nor river could have lain or flowed over this region. Nor can submergence beneath the sea be invoked in explanation. The bands containing the several characters above described are all flat or curved with definite relation to the present drainage-lines. This relation would be impossible were the loess a marine deposit. Not a single shell or other mark of the sea has presented itself to me in the original deposit. I am informed that Mr. McKay found a marine shell in the loess. I am compelled to conclude that it must have been obtained from a slope-deposit or other rearrangement of the original formation; in such cases they are not uncommon. The Timaru region has not been beneath the sea for long ages. The dolerite buries an older land-surface, with distinguishable soil, impressions of plants, worm-borings, and moa-bones; this soil being formed upon the surface of a considerable thickness—some hundreds of feet—of river-gravels, sands, and clays.

Having found the loess to be a dry-land deposit, we must find the still-missing factor in the dust-heap theory.

The Source of the Dust.—There was only one source possible in these latitudes for such a quantity of dust; and a mere hint as to its nature will suffice. If we consider the loess to belong to the great Ice Age there is no difficulty. The dust was "rock-meal," produced by the great ice mill, and spread out by rivers of sludge for the winds to dry, and pick up, and bear away, losing more or less of their load whenever they passed over a vegetated region. The material itself to-day bears testimony that such was its origin. Under the action of running water it tends to separate into darker- and lighter-coloured layers, the darker being the more oxidized particles. Sir J. von Haast remarked the resemblance of the stratified silt he saw to glacier-silt, and quite recent rearrangements by rains of the material of the cliff present precisely the same appearance. No other agent than ice could have produced so great a quantity of such fine material.

Other Loess Deposits.—The small dolerite sheet of the

Geraldine Downs—which in all probability was emitted simultaneously with the Timaru dolerite—is covered by a bed of clay several feet in depth. I have not examined this with instructed eye, but, as it could have been deposited in no other way, its origin may safely be declared to have been similar to that of the Timaru loess. It is a stiffer, "colder" clay than this of Timaru, and this fact may be accounted for by difference in the character of the dust supplied to the winds which formed it. I cannot doubt that examination of the loess on Banks Peninsula (described by Professor Hutton as aqueous) would result in like proofs of its subaerial origin being obtained. Other loess-fields in Canterbury would doubtless furnish similar evidence.

The descriptions I have read of the great loess-formations of the Rhine and of the "terrace" formations of North America, the origin of which, I understand, still puzzles European and American geologists, suggest to me in every detail that the dust-heap theory which explains the Timaru loess will also perfectly explain them.

In a small volume on the "Geology and Physical Geography of Brazil," by C. F. Hartt (Trübner, 1870) (which appears to be one of a series published under the title "Scientific Results of a Journey in Brazil; by Louis Agassiz and his Travelling Companions"), the author describes a "sheet" of arenaceous clay, very uniform in composition, "absolutely structureless," "totally devoid of stratification," usually quite free from pebbles or boulders. This sheet covers the coast provinces of Brazil from the level of recent estuarine formations—even extending beneath these—to the tops of the highest hills Mr. Hartt ascended. From his numerous topographical observations and his summary description of this superficial formation, which varies in thickness from a few feet to 100ft., I gather that it is a loess, and that it is probably of similar origin to the Timaru loess. The author and Agassiz could find no mode of deposition competent to account for all its features save a general glaciation of the country. It was a boulder-clay without boulders. The agency of dust-bearing winds, however, was not one of those taken into consideration by them.

A superficial deposit in Lower La Plata, described by Darwin ("Voyage of the 'Beagle'") as estuarine, "with concretions and bones," may also well be a wind-drifted dust formation.

ART. XLIX.—*On certain Rare Minerals associated with the Tin-ore of Stewart Island,*

By WILLIAM SKEY, Analyst to the Geological Survey of New Zealand.

With Notes on their Mode of Occurrence. By ALEXANDER McKAY.

[*Read before the Wellington Philosophical Society, 10th July, 1889.*]

TOWARDS the end of last March a large and valuable collection was submitted to me for examination. It comprised numerous minerals and specimens of rock-masses which were collected by Mr. McKay, during his recent survey of Stewart Island, from the stanniferous deposits and other rock-formations of the island.

The results of my investigations I briefly communicated from time to time, as obtained, to the Director of the Geological Survey; but, as there are many interesting points in connection therewith which have not been treated of in those communications, and which should be made public, I have thought it proper to address myself to this Society in a paper which shall deal with the whole subject.

The following are the full particulars of the results of my investigations of Mr. McKay's collection to date. The precise localities of the minerals that I shall describe, and certain interesting particulars as to their mode of occurrence, will be given as a sequel to this paper by the collector of the specimens:—

Beryl (Silicate of Alumina and Glucina).—This mineral as exhibited to me is in broken crystals belonging to the hexagonal system. Their cleavage is obviously basal. The diameter of the largest crystal is 1½in., and the length of the fragment in the direction of the longest axis is 1¾in. Colour, pale-green; subtranslucent; hardness, 8.

Fluor-spar (Fluoride of Calcium).—Highly crystalline; crystals derived from the cube. Colour generally pale-green; some parts colourless. The coloured parts exhibited vivid phosphorescence when gently heated.

Analysis.

Fluorine	48·12
Calcium	51·19
Loss (impurities)	0·69
	100·00

Tourmaline (Silico-borate of Alumina).—This specimen was handed to me by the collector as tourmaline, and it proved to be the ferruginous variety. It is black in mass, light-brown in powder. Occurs as columnar aggregations in quartz.

Topaz (Silico-fluoride of Alumina).—This is generally of a remarkably pure white, distinct from the whiteness of the purest quartz, from which it is easily distinguished by this character when the eye has been educated to it. The mineral occurs in a crystallo-granular form, permeating quartz or forming irregular-shaped masses in it, and frequently enclosing cassiterite and wolfram. It is infusible in the blowpipe-flame.

Analysis.

Silica	33·06
Alumina	57·02
Manganese	Trace
Iron-protoxide	0·11
Fluorine	14·82
	105·01

The excess of 5·01 in the sum of my results is owing to a part of the silicon existing in the mineral as a fluoride being computed as silica. The fluorine in this mineral was not certainly recognized by the blowpipe test, using a flux of microcosmic salt, the well-known etching-power of phosphoric acid itself standing in the way of this. However, by fusing the mineral with four times its weight of carbonate of soda, and treating the fused mass with sulphuric acid, very good reactions of this element (fluorine) were obtained.

Zinc-blende (Sulphide of Zinc).—A few very small, almost microscopic crystals, reflecting from certain of their planes a deep-blue colour, were brought under my notice by Mr. McKay. They were considered by him as likely to be a form of some inferior oxide of tungsten, an opinion which coincided with my own until I tested them. This proved to be a remarkable form of zinc-blende. The sulphide of iron in these crystals is in such proportionately large quantity as to colour the powder intensely black. The property that certain of these planes have of reflecting blue colour in ordinary light is one that to my knowledge has not been hitherto observed in connection with zinc-blende. In this respect they compare with the planes of some of the specular iron-ores from Elba and Cumberland.

Gahnite (Zinc-spinel). — Occurs as small light-green-coloured crystals, interspersed through certain of the matrices of the tin-ore of this island. These crystals belong to the isometric system: many of them are perfect octahedrons. They are infusible in the blowpipe-flame, but blacken therein. Owing to the very intimate admixture of this mineral with topaz, cassiterite, and quartz, I have not been able to separate it quite clear of impurities; but, as the impure mineral afforded me 18·14 per cent. of zinc-oxide and but traces of magnesia, and 5·71 per cent. of silica, I have not hesitated to name it as I have done—that is, gahnite, or zinc-spinel.

The somewhat rare mineral wolfram (tungstate of iron) I do not here describe, as it has already been identified by Dr. Black.

These comprise all the rare, or comparatively rare, minerals now known to exist associated with the tin-ore of Stewart Island. It will be observed that they comprise all, or nearly all, those minerals that are generally associated with tin.

In none of the other deposits of tin-ore known to exist in these islands has there been anything near the same variety of minerals discovered—for the simple reason, I suppose, that the other deposits have not been explored as completely as that in Stewart Island.

I should remark here that this is the first time that what I may term "rock-topaz" has been identified as existing in the colony. Perhaps this is because in this form it is easily mistaken for quartz by miners.

Regarding the very interesting mineral fluor-spar, this is the first time that its occurrence in the colony as a native product has been certified to upon good authority. Just recently, however, I had the pleasure of identifying the same mineral in a collection, made by Mr. James Park, F.G.S., representing the rocks and minerals of the Baton River, in the Nelson District.

I will conclude my part of this paper by stating my results upon certain other minerals of this collection which have also been analysed.

No. 5218, a white, soft, light rock, resembling siliceous mud, given to Mr. McKay by Mr. Russa, of Invercargill, contains very distinct traces of silver. On the authority of Mr. Russa the specimen is referable to the Paterson's Inlet district of Stewart Island. The quantity of material was not sufficient to allow the quantitative determination of this metal.

No. 5249. *Limonite.*

Analysis.

Water	19·24
Iron-sesquioxide	78·55
Siliceous matter	2·21
Percentage of iron, 54·88.	100·00

This is an excellent iron-ore.

No. 5250. *Wad* (manganese-oxides).

Analysis.

Iron-sesquioxide	7·42
Manganese-oxides	43·62
Alumina	Trace
Lime	Trace
Cobalt	0·46
Siliceous matter	2·29
Water and loss	46·21
	100·00

A very useful ore if in quantity and fairly accessible.

Notes by Alexander McKay, F.G.S., Assistant Geologist.

There are three distinct formations of Palæozoic date in Stewart Island. Of Secondary or Older Tertiary rocks there is not a trace. Outside the northern entrance to Port Pegasus there is a small islet formed of coarse and rudely-stratified granitic material, which I am inclined to refer to the Pliocene period. All the other deposits that have as yet been observed are obviously of Pleistocene or Recent date. These latter are of considerable extent in the district between the head of Paterson's Inlet and the west coast, and along the valley of Freshwater River. Away from the coast-line little is known respecting the geology of the north and north-east parts of the island; and what we do know of the formations along the coast-line is mainly due to the researches of Sir James Hector, who touched at Stewart Island in 1863 while engaged in exploring the south-west and west portion of the Province of Otago. More recently I have added something to a knowledge of the geology of the district around Half-moon Bay and the shores of the eastern part of Paterson's Inlet, and have collected from bushmen and prospectors some information respecting the west coast of the island north of Mason's Beach.

As I have mapped it, it would appear that in this part the country is mainly formed of granite, intersected by dykes of later date. Where I examined the district around Half-moon Bay, and along the shore of the eastern part of Paterson's Inlet, the rocks are gneissic schists, traversed in an east to west or north-west direction by massive intrusions of hornblendic syenite. These syenitic intrusions in every respect resemble—nay, to all appearances, are identical with—the syenites of Bluff Hill, on the mainland, and I am inclined to think that, however altered, the other rocks of the district are not greatly different in age. The less-altered rocks on the south side of Paterson's Inlet would, it appears to me, support this assumption.

From this district come two of the most conspicuous minerals in Mr. Skey's list. These are beryl and tourmaline. Both of these minerals are found together in a felspathic band, forming a selvage to one of the syenitic intrusions already mentioned. The tourmaline occurs in considerable plenty; the beryl is not so common, but yet not rare, and occasionally fine large crystals are to be found. The syenitic band runs nearly east-and-west along the north shore of the Inlet, and, from what I could gather, gets much more massive as it is followed to the westward.

Along the south side of Paterson's Inlet the rocks are of a different character, being subschistose and not so much altered; but in their structure it may be traced that originally

they were formed of fine-grained slaty breccia, sandstones, and slates. These rocks are also much intersected by dykes of a syenitic character. They also contain numerous irregular reefs of quartz, some of which are of very considerable size. On the coast-line east of Little Glory Harbour, and thence to Big Glory Harbour, I collected the rocks of this formation; and since my return Mr. James Thomson, of Half-moon Bay, forwarded a box of specimens collected further west, on the same side of the Inlet. I crushed a sample of the quartz from the sea-coast, but, though gold proved present, it was in quantities too small to pay. Strong traces of copper are found in a large quartz reef on the east side of Big Glory Harbour, and Mr. Thomson's collection included quartz containing galena, but this also in quantities too little to pay. The manganese-ore containing traces of cobalt was forwarded by Mr. Thomson, while the iron and kaolin clay were part of my collection from Little Glory Harbour and the coast-line.

At the time of my visit there was some excitement in Half-moon Bay on account of the supposed discovery of silver-ore in the rocks of the south side of Paterson's Inlet; and as I passed on my way to Port Pegasus I was shown a substance resembling kaolin clay which was supposed to be silver-bearing. I recommended that the samples should be sent to Sir James Hector, with the request that they should be tested for silver; but they have not yet arrived at the Colonial Laboratory. Mr. Russa, of Invercargill, just before my leaving, showed me some of the same or a similar material, resembling kaolin, and from him I obtained the small piece which Mr. Skey has proved to be argentiferous. Mr. Russa told me the specimen came from Paterson's Inlet. I have since written to Mr. Thomson to forward a sufficient sample of this clay, but it has not yet arrived.

The same formation as that from which these ores have been collected stretches along the west coast of the north part of the island, and along the coast of this part forms what is called the Ruggedy Ranges. These, from samples of the rock shown to me, contain similar reefs of quartz to those south of Paterson's Inlet, and at one place a copper-lode has been found, from which samples were sent to Melbourne some years ago, and were assayed at the Bank of Australia assay-office, and gave returns as high as 25 per cent. of copper, which was considered a good and encouraging result from specimens taken from the surface outcrop. I give the assayer's report below.

When I was last in Half-moon Bay a party was there on their way to give the reef a further trial, but had been wind-bound for several days, and at the time I left there was little probability of their getting away for some time.

Large bodies of marble rock resembling that from Caswell Sound, and certainly not inferior to it, are found not far distant from the copper-lode, and near Rugged Island there are large deposits of manganese-oxide.

South of Paterson's Inlet for the most part the country is formed of a soft grey granite, but there are belts of other rocks associated therewith, consisting of gneiss and mica rock, schistose or granular, and, in the Tin Range, very considerable bodies of a quartzose rock having a granular texture.

The typical granite rock is highly felspathic, and weathers into remarkable conical or dome-shaped mountains, of which Lee's Knob, on the east side of the main range and five miles north of Port Pegasus, is a remarkable example. The Deceit Peaks, to the west of the main range, are formed of the same rock, but have not the same regularity of outline as the granite hills on the east side.

Towards the southern extremity of the island, and west of the south arm of Port Pegasus, are two isolated mountains, called respectively Gog and Magog, which are also formed of granite, and are remarkable objects in the landscape.

The granite, where I examined it most carefully, towards the northern end of the Tin Range and in Lee's Knob, has numerous strong veins of felspar, and felspar and mica mixed. Small garnets abound in some parts, and there is a great abundance of glassy quartz closely approaching rock-crystal, which chiefly occurs in nests and segregations in the felspathic veins. The gneissic rocks are well seen on the shores of the north arm of Port Pegasus, more especially in a small bay three-quarters of a mile east of the landing-place.

At the head of this small bay there is, on its west side, a heavy reef of quartz full of iron-sulphide and traces of copper. Samples of this reef, known as Cross's Reef, I was informed had been sent to Melbourne, and, as reported, gave 5dwt. of gold and 13dwt. of silver to the ton. I tested for gold, but found none. This reef runs nearly east and west, and, on the opposite (eastern) side of the small bay, about one chain distant, it is seen to have greatly changed in character, and to be for the most part composed of felspar.

At the landing-place, survey-camp, and beginnings of the township that is to be, the rock is granite, with small veins of glassy quartz. At the head of the north arm of Port Pegasus, and along the lower course of Pegasus Creek, the rocks are schistose, with bands of pure mica rock, and reefs of quartz, felspar, and mica, or, in other words, the elements of granite; but the minerals are so coarsely crystallized, and the crystals so free of entanglement among each other, as is the case with normal granite, that one scarcely inclines to speak of such a rock as a granite.

These schistose and gneissic rocks are here, on the shore of the harbour, divided into two outcrops, as seen in section. They cannot be easily traced to the north, in which direction their exposures trend, although the strike of their lamination is between W.N.W. and N.W. South of the Tin Range there is a table-land about 750ft. above the sea, ending in a fringe of broken hilly country on the north side of the harbour. In the direct line of the crest of the Tin Range I sank a hole to the bed-rock, and found the rock pure mica, and so soft that for 18in. or 2ft. it was easily dug into with the shovel. But more to the north and west of this, at the same and higher elevations, the rock is granite—which, however, disappears at 1,000ft. on the west slope of the Tin Range—and mica and quartz rock, forming the higher part of the range.

The tin-bearing bands are segregations of quartz in the mica rock, which are traceable in the fashion of small reefs or leaders, sometimes continuously for a considerable distance.

The particular segregation-band in which tin-ore has as yet been found contains, besides the tin-ore, considerable quantities of wolfram, and at places a form of topaz is plentiful. The form of spinel mentioned in Mr. Skey's paper comes from the tin-deposit on the extreme southern end of the range, as does the peculiar blue variety of zinc-blende determined by him.

The sample of fluor-spar tested in the Laboratory was given me by a prospector, who stated that it came from Doughboy Bay; and I should say that its occurrence there is not improbable, seeing that the radical of the mineral is found in the topaz mineral obtained by myself from the Tin Range.

Topaz- and garnet-sand is plentiful in the alluvial deposits of the low ground within the watersheds of Pegasus and Smith's Creek, and is a great annoyance in collecting the tin-sands, more especially the grey topaz-sand. I have marked on the plan the areas of alluvial deposit over which stream-tin had been found at the time I left the Port Pegasus district. I am not aware that any fresh areas had been discovered, and none have been reported since.

Assay of Copper-ore.

Assay-office, Bank of Australasia.

Nos. 1, 2, 3, and 4: Mixed, principally copper-pyrites.—400gr. gave 74gr. of copper, or 18 per cent.

No. 5: Pyrites, with a little green pyrites.—Not enough in quantity to assay.

No. 6: Pyrites and black oxide.—400gr. gave 100gr. of copper, or 25 per cent.

Nos. 7 and 8.—Ditto.

No. 9: Not properly a copper-ore, but a substance called allophane, having from 2 to 4 per cent. of copper in its composition.—400gr. of this gave 12gr., or 3 per cent., of copper.

WILLIAM PATTERSON, Assayer.

I have made selections of all that is worth assaying, and have sent the numbered samples corresponding with the assay. The whole seems surface only, and, I think, gives very good encouragement for further search.—W. P.

ART. L.—*Descriptive Geology of the District between Napier and Ruapehu Mountain* viâ *Kuripapanga and Erehwon.*

By H. HILL, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 7th October, 1889.*]

THE geological character of the country between Napier and the extinct volcano Ruapehu, *viâ* Kuripapanga, has not, as far as I am aware, been published, nor do I think that route has been traversed by any one connected with the Geological Survey. In January of the present year, in company with Messrs. Petrie and Hamilton, I visited Ruapehu for the second time, and the following passing notes were taken during my journey by this route:—

The road might be described as running due west from Napier along the parallel of 39° 30′, and for all practical purposes it might be taken as being on the same parallel as Ruapehu and Egmont, the two highest and largest extinct volcanoes in New Zealand. The distance between Napier and Ruapehu by road would be about 110 miles; but as the crow flies the distance is about seventy, Ruapehu being about midway between Napier on the east and New Plymouth on the west of the North Island. As far as Kuripapanga, fifty miles from Napier, the drainage belongs to the Hawke's Bay river-system; but beyond this the chief drainage is into Cook Strait and the South Taranaki Bight. The country between Napier and the Erehwon plateau resembles an inclined plane, through which run river-valleys transverse to what was at one time a great plain of denudation for most of the East Coast country, extending from Poverty Bay southward as far as the Wairarapa Valley. Generally it may be said that the road to Ruapehu and the volcanic district south of Lake Taupo by way of Kuripapanga passes through the country drained by

the Tutaekuri in its lowest and middle course, the Ngaruroro in its middle and upper course, the Rangitikei in its upper course, and the Whangaehu also in its upper course.

Between Napier and Woodthorpe, situated fifteen miles up the Tutaekuri River, all the hills are composed of limestones and marls corresponding to the upper division of the Napier series. The river-terraces which are met with between Puketapu and Woodthorpe correspond to the Kidnapper pumice and conglomerate beds. At the latter place the Kidnapper beds have large exposures, and they occupy the hills to a height of more than 400ft., and in all cases blue clays and marls are seen to underlie the terrace-beds. From Woodthorpe the road passes for some distance through the bed of the Tutaekuri River, the banks of which are very high, and are composed of blue clays and marls on either hand. Overlying the marls are shingle-deposits of various thicknesses, mixed in places with thin bands of pumice-sands and clays, whilst the character of the surface of the old plain of denudation, at the top of the clay-marls, is clearly seen throughout the whole of the valley. In two instances the exposures show pumice-bands, which form such a characteristic feature of certain of the blue clay-marls over a great extent of country along the east coast. In places the blue clays are crowded with fossils, whilst in others they are few and very brittle, which makes it difficult to collect good specimens. The following were among the more common of those seen in this portion of the district: *Dentalium giganteum*, *Natica* (?), *Ostrea edulis*, *Pectunculus laticostatus*, *Anomia* (?), *Waldheimia lenticularis*. For some distance after the road leaves the bed of the river the uplying lands and river-terraces, through which pass several deep transverse creeks, show exposures of the same clays and shingle-deposits, whilst here and there traces of limestone are met with, and limestone is also seen to top all the highest hills which form the watershed of the smaller tributaries on the right and left banks of the river. As far as Waikonini the country presents little or no change in the rocks from what may be seen a hundred times exposed in the river and streams near Woodthorpe; but from this point new physical aspects present themselves, as the plateau which is now reached, and which is known as the Matapiro and Aorangi Plain, shows limestone outliers in the small hillocks which now and again appear by the roadside. The surface-soil appears to be composed mainly of grit, pumice, and scoria, which between here and Karioi, situated to the south of the great Ruapehu, takes the place of the fine porous pumice which is found over the country further to the eastward.

This plateau appears to have been formed by the breaking-up of the limestones when the elevating forces caused the

chain of the Ruahine Mountains to appear through what was at the time a limestone country, extending from the east to the west coast. At the time when this elevation was in progress, denudation was great, and the fractured limestones were much worn by the shattered and indurated slates, which had probably been subjected not merely to great pressure, but also to heat-zones, such as might be expected at the beginning and during the progress of the volcanic period which caused such marked and extensive changes in the physical aspects of the North Island. These limestones correspond, and, in fact, are identical, with the Maunga-haruru limestones as seen so well exposed in the great scarp at Te Waka, on the Taupo road overlooking Pohui. They have, however, been so worn, and ground, and powdered within the area under notice that only in isolated spots one sees—just as one sees on the flanks of the Whakarare Mountains, in the Kereru district, further south—the remnants of an extensive limestone range, of which few traces remain, so great was the denudation which succeeded the earth's movements referred to above. In the Otaharuru Creek, at Glenross, near the fellmongery of Mr. Williams, lenticular limestones appear, interbedded with the blue clays and clay sands, as seen near the crossing. *Terebratula*, *Ostrea*, and *Anomia* shells are common, and in several places broken portions of *Pinna* shells were also numerous.

From this place the road passes over the hills to Mount Blowhard. Many of the exposures by the way show limestones, but as the top of the range is reached fossiliferous sandstones appear. The sandstones over a large extent of the elevated country have comparatively recently become quite denuded of vegetation, the fires which raged over the country for the destruction of fern and scrub having destroyed all the roots which bound the soil to the decomposing rocks. The bared sandstones provide an excellent collecting-ground for fossils, as in many places they are crowded with specimens of coral in an excellent state of preservation.

At a spot where the road passes the joining saddle of the range some very remarkable limestones appear. They resemble a series of organ-pipes, are fluted like them, and arranged in columns and tiers as in an immense organ-chamber, presenting a very grand and imposing appearance, the concave and convex flutings being exceedingly perfect. These flutings have no doubt been caused by chemical and aerial agencies: it seems to me, however, somewhat difficult to account for the perfection of so many hundreds of flutings, with such regular concave and convex surfaces, by chemical means alone, as in texture the limestones to all appearance were the same, and the concave and convex surfaces appeared equally hard.

It is difficult, somewhat, to trace the relationship between the limestones and the sandstones, but possibly they pass one into the other, and are the corresponding beds to the fossiliferous grits and sands as seen when approaching Te Hauroto from Mohaka, on the Taupo road. The Te Hauroto limestones, however, which overlie, and in places pass into, the grits, abound with fossils; but, as already remarked, no fossils were noticed in the fluted limestones such as were exposed on the top of the saddle near Mount Blowhard.

Between this place and the top of the next hills, which really separate the basins of the Ngaruroro and Tukituki Rivers, the country is somewhat broken, but there are few exposures in the roadside. A little to the southward great scarps are seen facing to the westward, and overlooking the valley in which Kuripapanga Hotel is situated. Such rocks as are exposed in the cuttings by the roadside appear to be of a tufaceous character, brownish in colour, and almost identical with tufaceous rocks found on Ruapehu at a height between 5,000ft. and 6,000ft. Although somewhat porous in texture, it is a difficult rock to fracture, and appears to have plenty of wearing-power. The soil covering the hills is of a reddish-brown colour, with pumice grits and pebbles. Here and there over the surface of the ground are white-quartz pebbles, well rounded, and generally in small heaps of a dozen to a score. These pebbles, Mr. Hamilton informs me, are moa crop-pebbles; and if such is the case it would seem that moas not so long ago must have been extremely numerous in this district. It might be mentioned in support of this that many moa-bones have been found scattered over the country between Mount Blowhard and Karioi, a small settlement a few miles south of Ruapehu Mountain; and as the country becomes better known and caves explored no doubt evidences of the moa will be largely increased.

From this place to Kuripapanga, which stands upon the Ngaruroro River, the country is very broken, and there are accumulations in places of pumice pebble-deposits, which would seem at one period to have choked up all the old water-ways and formed plain-terraces of rather large extent. The terraces on this line of road begin on the same longitude, or very nearly so, as on the Taupo–Napier Road, where pumice sands and pebbles are first met with as terrace-deposits near the Mohaka Bridge; and after the Taurangakumu Hill has been crossed the terraces are traceable right on to the Kaingaroa Plains. At Kuripapanga the pumice-deposits fill up the valley, and overlie coarse bouldery shingle of a semi-conglomerate character. Underlying the shingle on the left bank of the Ngaruroro are blue clay-marls

full of bivalve shells, a *Kellia* predominating. In the bed of the river near the bridge is an excellent section showing the fossiliferous clays resting on the slates, which for the first time make their appearance in this direction, although some distance above and below the bridge the slates are the only rocks exposed on either bank of the river. I remember that a similar section, showing clay and sands resting on the slates, is met with in the right bank of the Tukituki River at a place known as the Khyber Pass, on the flanks of the Ruahine Mountains. There the slates and blue clay-sands meet, the latter at their junction with the slates presenting the appearance of the bow of a boat. On the right bank of the Ngaruroro, at Kuripapanga, large deposits of pumice are found for at least 200ft. above the river, and there are no traces whatever of the blue clay-sands in this direction. The high hills between Kuripapanga and Ohauko scarcely change in their rock-characters the whole way, except that on the former side of the hills the slates show cleavage-structure, whilst on the Ohauko side they seemingly run into sandstones and present the appearance of having been affected by igneous agencies. Traces of pumice are to be met with over all the hills in this direction, and in places where pockets have been formed it is many feet in depth. About midway between Kuripapanga and what is known as the Taruarau Spur the blue clays reappear, and are overtopped here and there by bands of lenticular limestones. These clays and limestones cover a large part, so it would seem, of the Ohauko plateau; but the pumice which covers the surface diminishes greatly the value of what otherwise would be a rich district. The clays are fossiliferous, but the limestones, though composed mainly of broken shells, do not provide any specimens which it is possible to identify with certainty. As the road leads into the Taruarau River the pumice-terraces reappear, and they overlie the marls on the left bank and the slates on the right just as they do at Kuripapanga. On the latter bank the pumice is very deep, and large trees of charcoal, with branches and roots intact in some cases, are exposed in the pumice, and present an appearance as if a forest had been suddenly submerged by a vast deposit of hot pumice, and ignition had taken place as it does in the ordinary process of charcoal-manufacture. As at Kuripapanga, there is no trace of marls or limestones on the right bank of the river; nor do these rocks again appear until towards the top of the ascent of the Taruarau Spur, where several blocks of limestone are seen at a height of about 2,600ft., or about 450ft. below the top of the hill known as Otupi. On Otupi the rocks resemble those which flank the western side of the Kuripapanga Range, except that they are harder and of a somewhat deeper blue. When

broken the grain is coarse and the fracture irregular, with extremely sharp edges.

Between this place and the Rangitikei River, near Kelly's accommodation-house, the distance is nine miles. The country is bossy, and is a plateau varying between 1,800ft. and 2,500ft. in height. Exposures by the way-side show limestone scarps, and in several places the scarps show the dip of the rocks to be towards the S.E. and S. at a low angle. But the dip, as might be expected in a district which has been so much affected by earth-movements and volcanic explosions, varies very rapidly as one passes along the plain, and little value can be set upon the dip of the rocks in this locality. When nearing the Rangitikei the road descends rapidly towards the deep, narrow valley through which the river has cut its way. On the left bank, below the crossing, great scarps of blue clay-marls overtopped with limestones are seen, and they appear to be similar to those at Ohauko, and which disappear in the left bank of the Taruarau Stream, as described above. Towards the top of the Rangitikei Hill, by way of the newly-formed road leading to Erehwon, coarse limestone blocks are exposed by the wayside. These contain rather large-sized pebbles and many fragments of bivalve shells, of which *Ostrea ingens* and *Pectunculus laticostatus* could be distinguished. In this hill slates and fine and coarse sandstones are found, the latter being in connection with the limestones. At the top of the hill the Upper Patea district is reached, and limestones again top all the hills in the whole of this somewhat extensive plateau, of which Erehwon is the centre. The height of the limestones would vary from 2,700ft. to 3,000ft.; but on the margin of the volcanic basin, towards the north-west, limestone is found in the scarps of the hills which overlook the volcanic basin at a height of not less than 3,500ft. above sea-level. At Moawhanga, a native settlement five miles or so beyond Birch's homestead, the river has cut out for itself a deep channel in the blue clay-marls which are largely exposed in the whole of the valley. These clay-marls are very fossiliferous in certain places, and sometimes concretionary limestones are found interbedded with them. The same fossils were collected from them as from the blue clay-marls in the Tutaekuri River already described.

From Moawhanga to Mapouriki, on the Whangaehu River, five miles or so due east of Ruapehu, the distance is twenty-two miles. For about half the distance the country partakes of a limestone character, the limestone being interbedded with calcareous sands, which are fossiliferous, but the shells are so broken that it is difficult to give with certainty their specific names, except *Ostrea edulis, Pecten triphooki, Cardita zealandica, Hemimactra elongata, Anomia* (?). On the border

of the volcanic basin the limestones present a series of remarkable scarps in the direction of Ruapehu, and it would seem as if the limestones had at one time covered the country now occupied by volcanoes and volcanic products.

Our party pitched camp at Mapouriki, and spent several days in the vicinity of Ruapehu and the Rangipo Desert. The whole of the volcanic district had been visited by me two years before, and I had ascended Ruapehu on the western side for a height of nearly 6,000ft. From Mapouriki no attempt was made to get to the top of the mountain, but our party, if I may say so, went into it. Ruapehu is an immense truncated cone, whose crater has been blown out on the eastern side. There now remains a kind of amphitheatre, with perpendicular walls on three sides not less than 1,200ft. in height. In the middle of this vast cinder-heap stands the neck of what was at one time a volcanic vent. From this isolated pedestal, the top of which is more than 7,000ft. above sea-level, an observer commands a full view of the everlasting snow-fields, and can see the sources of the Whangaehu, separated from that of the Waikato by a low saddle. The grandeur and sublimity of the scene, combined with its awful weirdness and desolateness, need not be described here. My purpose was to see the rocks, to collect specimens, and to observe the effects of volcanic phenomena. I had now traversed the whole of the volcanic district, and it will be my aim to deal with the question of volcanic phenomena in a second paper.

From what has already been stated with regard to the rocks between Napier and the volcanic basin, it will be inferred that no rocks of the younger Secondary formations are met with, nor even of the Lower Tertiaries. The last appearance of these is between Te Aute and Waipawa, so that they do not even come within the range of the district under notice. The blue clays and marls are similar to those so common along the east coast, more especially in the northern part of Hawke's Bay, and which in a former paper I ventured to term Miocene. The limestones between Moawhanga and the volcanic basin are younger than most of the other limestones, and are closely allied to those of the Pukekuri Hill, near Taradale, which contain sandy clays, and belong to the Petane or Napier upper series. The other limestones are intermediate between these and the clay-marls of the Miocene rock. The Woodthorpe beds are the youngest of the Pliocene rocks, and have their representatives over a large extent of country eastward of the Ruahine and Kaweka Mountains. The pumice-terraces appear to belong to the same period of deposition as the Woodthorpe beds. The slates I am doubtful of, as, although carefully sought after, no traces of fossils

have yet been met with in any of the slate rocks of this district. The members of the Geological Survey have classed them as Palæozoic, and the name has been retained here, though its meaning is so wide and indefinite.

ADDENDUM.—Since the above paper left my hands I have again visited the volcanic district by way of Kuripapanga, and I find that the sands referred to as being seen at Blowhard underlie the limestones and pass into streaky clay-sands, which are the upper beds of the slates. In two places near Blowhard Secondary rocks appear similar to those seen at Kuripapanga. On the hill known as "Gentle Annie," beyond Kuripapanga, there is to be seen on the roadside a large limestone boulder. This rests on the slates, and is, I suppose, a remnant of the limestones which once covered the whole of the hills in this district. The highest limestones appear about midway between Erehwon and Ruapehu, at a height of 4,720ft. They rest on the Secondary rocks, and are full of fossils, mostly bivalves.

ART. LI.—*Artesian Wells: No 2.*

By H. HILL, F.G.S.

[*Read before the Hawke's Bay Philosophical Institute, 7th October, 1889.*]

Plate XXXI.

As an addendum to the paper read by me two years ago* on the artesian-well system of Hawke's Bay, the following additional facts will be found of interest and importance. For those not acquainted with what is known as the Heretaunga Plain, it may be explained that in this paper it includes the district extending from Napier to Pakipaki, with the Borough of Hastings towards the centre. The distance between the two places is about eighteen miles, with a breadth varying from eight to ten miles. Within certain limits this plain is an artesian water-bearing basin sloping to the north-east, and troughing on the south-east to the north-west, and on the north-west side to the south-east; thus forming a syncline between the two opposite exposures extending for about ten miles.

Since the date of the paper referred to, which treated as fully of the subject under notice as it was possible to do with

* "Trans. N. Z. Inst." vol. xx., p. 282.

the data then available, many wells have been sunk in various parts of the plain, and, as far as I am aware, they all tend to show the truth of the inferences drawn by me as to the formation of the artesian basin in the district under notice. But among the numerous sinkings which have been carried on to supply the growing wants of population and settlement there are four wells, or, rather, four sinkings, to which I wish to direct particular attention, as they provide information of much geological interest and importance in connection with the formation of the plain, and its relation to the other rocks in the district. Of the four wells referred to, two of them were put down within the Borough of Napier, one in the immediate vicinity of Napier, at a spot locally known as the Western Spit, and the fourth one was sunk at the Greenmeadows, situated a mile or so on the Napier side of the Township of Taradale. (See topographical map of plain, "Trans.," vol. xx., p. 284.) The two Napier wells were successful ones, each having an excellent flow; whilst the other two—viz., the one at the Spit and the one at the Greenmeadows—were failures.

In certain places water is found in the vicinity of the Greenmeadows; but the spot selected for the sinking referred to here is within a few chains of the hills, which are composed of marl and limestones, and which hereabouts have had the more sloping portions fronting the plain slowly ground down by the back-wash at a time, not so long ago, when the sea covered this portion of the district. The sinking for water in this place has proved conclusively—so it seems to me—the limit of the artesian basin in this direction, as no trace of water was met with, and the characters of the beds passed through differ greatly from those that are found within the true artesian basin. During the process of sinking I visited this well, and from the workman in charge gleaned that after the first 24ft. had been passed, of which 10ft. were made up of shingle, there were 96ft. of a yellowish clay—pumiceous clay or loess—similar to that covering most of the Napier hills and district at the present time. This has evidently been washed from the surrounding hills as the plain was in process of formation. Following this clay was a succession of blue-clay beds, which continued as far as the sinking was carried—viz., 273ft.—except that at the depths of 140ft. and 181ft. 6in. respectively a bed of fine pumice-sand about 18in. in thickness was passed through. The appearance of these two pumice-bands is a very interesting geological find, as they give a clue to the relationship between the Kidnapper beds at the point and those which abut on the artesian basin to the north-west of the plain. Clay-marl beds containing one, two, and sometimes three pumice-bands are traceable over a large extent of coast and inland country (see "Trans.," vol. xx., p. 273), and

wherever met with it is observable that they are either overlain by limestones, with pumiceous clays atop of them, or by shingle, pumice, clay, and conglomerate beds corresponding to the Kidnapper pumice and conglomerate deposits, such as they appear to the south-west of what is known as the Black Reef. In my first paper on artesian wells I endeavoured to show, first, that there is a gradual slope in the water-bearing beds between Pakipaki and Napier; second, that the beds trough along their south-east and north-west edges, being deepest, or nearly so, midway between Taradale on the north-west and the place known as the Grange on the south-east; and, third, that the beds are recent, and have been formed by the filling-up of what was once a portion of the sea known as Hawke's Bay. The abandoned well at Greenmeadows, situated at the western end of what is locally known as Avenue Road, shows that the artesian beds die out in this direction as the hills are approached. According to the average depth of the wells at Taradale and at the Greenmeadows eastward of the well under notice, water should have been reached at the extreme depth of 125ft.; and, as none of the ordinary artesian beds was found except the overlying shingles, and perhaps a portion of the pumiceous clay which appears in the wells in Napier when approaching the hills, it would seem that hereabouts the upper deposits, which are the youngest of the plain-beds, overlap the true artesian beds and the blue marly-clay beds containing the pumice-bands, the artesian beds and the clay-marls being unconformable to each other.

Second Well, Western Spit, Napier.—The locality of this unsuccessful well is at the back of the hotel on what is locally known as the Western Spit. It was sunk with a view to supply the requirements of the South British Company, whose meat-freezing works are in the immediate vicinity; but after sinking to a depth of 328ft. the work was abandoned. I believe that in a former attempt to find water on the Spit side of Napier the pipes went down to a depth of 420ft., but no record as to the character of the beds passed through has been kept; otherwise inferences based upon ascertained facts might have been drawn as to the chances of finding an artesian water-supply on the Port side of the town. Unfortunately, I was absent from town when this well was being put down; but Mr. Garry, to whom I am so much indebted for valuable information in connection with the artesian wells on the Heretaunga Plains, has supplied me with all the information in his possession as to the beds passed through. He reports that at the depth of 328ft. hard limestone was struck, and that this circumstance caused the well to be abandoned. As far as can be gathered, the beds passed through are true water-bearing

beds, and correspond in general characters to those found within the artesian basin of the Heretaunga Plain. But, although the beds to the north and south of Scinde Island are almost identical in character, they belong to two distinct basins of deposition, being separated from each other by a ridge of rocks running from the lowest of the Napier limestones in the direction of the Greenmeadows and the Quarantine Station. This will be evident from what has already been stated as to the dip of the beds between the Greenmeadows and Napier in a south-east direction. From a careful study of the beds between Petane and Napier I am inclined to the opinion that water may be expected within certain areas of what is a very limited district; but it may be that the formation of the basin is such as to debar the possibility of flowing wells, like those which are so common on the Heretaunga Plain. The area composing the basin of the inner harbour, as far as Petane, appears to have no connection with any body of fresh water except the Esk River, which in its lower reaches passes over beds corresponding to the Kidnapper pumice and conglomerate beds. The road from Napier to Petane is a shingle-deposit like that between Napier and the Kidnappers. This deposit separates what is known as the inner harbour from the ocean proper; the inner harbour on the Petane side representing an area corresponding to the Heretaunga Plain. Through this shingle-band water percolates to and from the ocean and the inner harbour, according to the state of the tide. The shingle has a depth reaching in places to as much as 100ft., but it is curious that not far from the place where the abandoned well is situated there is a spring of fresh water of good quality, and during the driest season the supply is fairly plentiful at a depth of a few feet in the shingle. This fresh-water supply cannot be from shingle drainage, as no fresh water is found elsewhere along the Spit; besides, the dip of the shingle is not in the direction of the fresh-water spring. Possibly this fresh water may point to the existence of a break in the beds below the shingle, through which the water passes, and reaches to the height which may be expected should a well be put down in this place. It is observed that in places on the Heretaunga Plain, and even in Napier, the artesian water has forced itself to the surface, in small quantity, up the outside of the tube-bore; and the saturated salt-water shingle-beds would act somewhat like a tube-bore to the fresh water of less specific gravity as it rises towards the surface. Personally, I do not feel satisfied with the results of the tests for artesian water on the Western Spit. The beds are certainly similar to those met with on the Heretaunga Plain, and more particularly to those presently to be described; and, although, as previously pointed out, the wells belong to two

separate basins, there is no reason to suppose that the water-beds are absent in the one whilst being present in the other. Possibly the places hitherto selected for sinking were too near the hills. On the south side of Napier the rule holds good, for the water-bearing beds are lost as the hills are approached. For my part I should very much like to see another attempt made to put down a well on the Western Spit by what is known as the "shelling-out process."

A test-well at this place would settle once and for all whether artesian water is obtainable or not on the Port side of Napier, and such knowledge would go far towards encouraging the establishment of manufactures in close proximity to Napier and to the seaboard. It seems to me that public bodies like Borough Councils, Harbour Boards, and County Councils might expend a portion of their funds in less useful ways than testing for a good water-supply in places where the community as a whole is likely to be benefited; and I, for one, shall rejoice to see the day when public bodies like those named will recognize that the co-operative principle in providing for the common weal is not only the cheapest, but the one most likely to lead to the rapid development of production and of industries among communities.

Third and Fourth Wells, Napier.—The two wells to which reference will now be made are situated in Munro Street, Napier, on what was until eight years ago a portion of dead water known as the "Napier Swamp." The first of these two wells is located some distance from the south-eastern boundary of Clive Square, and the second well is just 14 chains further away from the same boundary in a south-east direction. Clive Square is at the foot of the limestone hills forming the so-called Scinde Island, about midway between the north-east and south-west ends, so that the sinking of these two wells in a straight line from the hills is of value as showing the inclination of the water-bearing beds, whether towards the limestones or away from them. The value, however, is much enhanced by the fact that 19 chains further away from the hills, along the same street, and exactly at the junction of Munro and Hastings Streets, another well was put down three years ago, so that in the same straight line extending from the foot of the Napier Hills in their central part there are three artesian wells, the exact depth of each being known, and the geological characters of the beds in the two wells under notice being also known for each foot and portion of a foot passed through during the process of sinking. These two wells were authorised to be put down by the Napier Borough authorities to provide for the growing requirements of the town, and they differ from any of the other wells in this district in their having a much larger tube-bore,

being 6in. in diameter, whilst the largest up to this time were wells of a 3in. bore; so that the sectional areas are as 36 to 9, or 4 to 1. The mode of putting down these wells was entirely different from that formerly adopted in this district. I have been particular to locate these wells, as they are of special importance, for they show in the clearest manner the troughing of the water-bearing beds in the direction indicated by me three years ago. The first well—that is, the one nearest the hills—was sunk to the depth of 156ft. before the water-bearing basin was reached. The beds passed through in this well were as follows: Shingle, 58½ft.; fine white limestone, 1ft.; pale-blue shingle, interbedded with 2ft. of hard brown clay, 18ft.; blue clay, with shells, 22ft.; fine blue sand, with thin clay-bands, 9ft.; blue clays, with sand-and-shell band, 6ft.; fine blue sand, with shells, 3ft.; rather coarse blue sands, in places full of shells, 30ft.; clay, with thin sand-bands containing bits of water-logged wood, 8ft.; shingle, the water-bearing bed. When water was struck the artesian well at the railway works, some distance away, diminished the height of its flow about 20ft.; but this was only temporary, as the pressure again returned, and I understand that the flow at the railway well now shows no appreciable diminution. The characters of the beds passed through were very similar, except that in the first well, after passing through 58½ft. of shingle, 1ft. of fine white-limestone sand was met with. This was followed by 16ft. of blue shingle, about the middle of which was a hard pumiceous clay-band, nearly a foot in thickness. In the second well (see section, Plate XXXI., fig. 1) no limestone-sand band appeared, nor was there any pumiceous clay; but some of the pebbles brought up were of limestone similar to the Napier limestone. Below the shingle were alternate beds of blue clays and blue sands. When passing through the blue sands in each well fresh water appeared, and at times it rose in the pipe to within a few feet of the surface. Fresh water in these beds may be the result of percolation from the true water-bearing basin, as the beds run out towards the Scinde Island limestones. It has been explained that the first well put down in Munro Street was 156ft. in depth; the second well, which is 14 chains further from the hills, is just 40ft. deeper, or 196ft.; whilst the well at the junction of Munro and Hastings Streets, to which reference has already been made, is 230ft. in depth: so that the evidence is complete for the following statements:—

1. That the artesian beds die out towards the Napier hills just as they do towards the hills at the Greenmeadows.

2. That the beds dip apparently to the south-east at the rate of between 2ft. and 3ft. to the chain, which corresponds to a dip of little more than 2°.

The flow of water from each well is at the rate of 270 gallons a minute, or, say, 16,000 gallons an hour, or 384,000 gallons a day. Thus, these two wells, representing the work of a forty-horse-power engine, supply more than three-quarters of a million gallons of water daily, of exceptional purity and suitability for domestic purposes. The cost of sinking the two wells, including £64 for boring-tools and £30 for bonuses, amounted to £534 16s. 7d., which at 7 per cent. interest represents an annual outlay of less than £38, and for which the town is supplied with more than 280 millions of gallons of water ready for use. The water as it rises to the surface exerts a pressure of about 13lb. to the square inch, corresponding to a rise, when allowance is made for friction, of about 30ft. above sea-level. The head-pressure exerted on the water at the bottom of the well, which is 196ft. in depth, in order to raise it 30ft. above sea-level, is equal to about seven atmospheres on each square inch. This will show how very necessary it is when sinking a well to insist upon pipes being used of the very best description, as in the case of the well just mentioned the pressure upon the lowest section of the pipes amounts to over 100lb. to each square inch. With such a pressure it is easy to understand why so many artesian wells begin to diminish their supply of water after the lapse of a few years, as they become choked by the rotting portions of the pipe towards the bottom of the well.

But the sinking of the two wells in Munro Street has not merely given information as to the dip and general character of the beds overlying the true water-bearing bed: by the "shelling-out process," which was adopted in sinking, interesting information has been brought to light as to the age of the overlying beds. This has come about by the discovery in the blue-clay sands of a large number of very small shells in an excellent state of preservation. The common cockle-shell and a whelk had been the only shells noticed in previous sinkings, but it is now known that shells are common in most of the beds passed through during the process of sinking, except, perhaps, in the clay-sandy bed which immediately overlies the water-basin. In this bed much vegetable matter is met with, but no trace of shells as far as I have been able to discover, and I am inclined to the opinion that the clay-sandy bed which rests upon the water-bearing basin is of fresh-water origin, and, if not unconformable to the overlying beds, at least represents a change in the area of deposition to which reference will presently be made. The following is a list of the more important shells found in the beds during the process of sinking the wells. They were referred by me to Professor Hutton, of the Canterbury College, who kindly sent me the names of the different specimens received by him:—

Gasteropoda: *Amphibola avellana*, Chem.; *Trophon ambiguus*, Phil.; *Trophon duodecimus*, Gray; *Trophon plebeius*, Hutton; *Cominella lucida*, Phil.; *Clathurella sinclairi*, Smith; *Turbonilla neozelanica*, Hutton; *Odostomia lactea*, Angas; *Potamopyrgus corolla*, Gould; *Pantipodus*, Gray; *Trochus tiaratus*, Q. and G.; *Cantharidus tenebrosus*, Adams; *Monodonta æthiops*, *Acmea flammea*, Q. and G.; *Conus neozelanicus*.

Lamellibranchiata: *Tellina glabrella*, Des.; *T. subovata*, Sowerby; *Venus stutchburyi*, Gray; *V. mesodesma*, Q. and G.; *Tapes intermedia*, Q. and G.; *Kellia citrina*, Hutton; *Nucula lacunosa*, Hutton.

I believe that all these shells are to be found to-day, if not in the immediate vicinity of Napier, certainly on some portion of the coast-line of New Zealand. They belong to animals which frequent tidal mud-flats like those of our inner harbour, or comparatively shallow waters in quiet bays and coves. The shells named above are found extending from a depth of 112ft. to 175ft. below the present sea-level, and there is every appearance of the animals which once occupied the shells having lived in the sands and sandy clays where the shells are now found. Similar deposits to those in which the shells were found are scattered over the whole of the district included within the artesian basin—varying in thickness, but, on the whole, maintaining their general characteristics. I am informed by Mr. Hamilton, our secretary, that the animals which occupy shells of the kinds named do not now live at such great depths as those where the shells were found during the process of sinking; hence it must be inferred either that the animals have modified themselves to altered conditions since the beds overlying the artesian basin were deposited, or that these beds have been deposited on what was a subsiding area.

Before deciding this question it will be necessary to see what information may be gathered from the rocks surrounding the Heretaunga Plain, which represents the area referred to. At one time, not so long ago considered as a geological period, the Kidnapper beds were united to the Redcliffe-Taradale beds. Between them that portion of the plain now intervenes which is the very centre of the artesian basin. The Kidnapper beds dip N.W., whilst the Redcliffe beds dip S.E., so that a syncline, extending for about ten miles, is formed between these two conglomerate and pumice series. The limestone range behind this series runs south-west, forming bold scarps behind Havelock, in the Tukituki Valley. The least observant must have noticed the peculiar slope of these limestones as seen from Napier. These rocks dip N.W., at a fairly high angle under the Heretaunga Plain, the tilt being as if the rocks had suddenly snapped away from the

limestones covering the hills farther to the south-east, and had fallen towards, and were about to slip underneath, the plain. At Napier the general dip of the limestones is N.W., just as at Havelock; whilst the limestones to the south-west of Redcliffe dip S.E. and form with the Havelock limestones.

Here, then, on the north-west and south-east sides of the plain, are deposits of enormous water-carrying capacity passing under the plain, forming a longitudinal trough, open towards the ocean, and overlain by a series of beds that have been deposited on a subsiding area. That the Heretaunga Plain, the Kidnapper conglomerates, and the area around Pakipaki have been disturbed by earth-movements, even within the memory of living evidence, is beyond question. In the great earthquake of 1853, which was felt over the larger portion of the colony, I am informed by our ex-president, the Rev. William Colenso, F.R.S., that the Ngaruroro River overflowed its banks at Waitangi, near Clive, and the ground showed a rift 10in. to 12in. wide, running north-west and south-east across the plain, through which rift a lambent flame flickered for some time. A similar phenomenon was noticed by the Maoris who then dwelt on the west of the inner harbour, and so frightened were they at the unusual event that they quitted the locality. Disturbances were also noticed at Pakipaki, and the land in some places was raised several feet in height. It was during this earthquake that the Kidnapper conglomerates were riven and torn in many places. These rifts may still be seen, and they can even be distinguished by an observer standing on the Napier hills by the circumstance of the conglomerates falling in sections towards the north-west, and by the greater slope of the north-west side of each rift than of the south-east side. Here, then, the evidence seems clear that the Heretaunga Plain has been built up on an area of subsidence, and, such being the case, it is easy to account for the appearance of shells—shallow-water shells—at comparatively great depths, together with bits of wood, raupo, and even resin from the rimu-tree. The beds overlying the true water-bearing beds overlap limestones and conglomerates, and it is to this circumstance that the flowing wells are due, as the water in the underground basin is unable to find an outlet, except by percolation where the beds thin out underneath the ocean. As to the age of the artesian and overlying beds, it will have been inferred that they follow in succession the upper shingle-deposits belonging to the Kidnapper beds. No single extinct shell has been found among those brought up with the sands from the wells, as enumerated above. Curiously, all the shells are represented in the rocks forming what is known as the Wanganui system, an upper division of the Pliocene formation, a list of fossils from which appears in

a paper by Professor Hutton, "Trans.," vol. xviii., p. 336. That they are Post-tertiary I think there can be no doubt, the shingle-spit running from the Kidnappers to Tangoio forming the youngest deposit of the series in this district.

The following section (Plate XXXI., fig. 1) represents well No. 2, Munro Street, Napier, as put down between the 10th May and the 1st August, 1888, at a cost of £281 9s. 11d.

IV.—BOTANY.

Art. LII.—*Descriptions of New Native Plants.*

By D. Petrie, M.A., F.L.S.

[*Read before the Otago Institute, 11th June, 1889.*]

1. *Ranunculus areolatus*, nov. sp.

A small, slender, almost glabrous herb. Radical leaves on slender, glabrous, striate petioles that are 1in.–2in. in length; blade $\frac{1}{3}$in. long, $\frac{1}{2}$in. broad, thin, cut to the middle into three oblong gently-rounded obtuse lobes (of which the two lateral ones are often cut by a shallow, wide incision), glabrous, or with a very few simple hairs on the margin and under-surface; veins evident below, forming large oval areoles on the under-surface of each lobe.

Scapes simple, slender, elongating considerably after flowering, with two semi-amplexicaul cauline leaves, the lower cut to the middle into three long linear lobes, the upper broad and entire, sparsely clothed with delicate silky hairs at and below the apex.

Sepals not seen; petals five, oblong, with a narrow claw and three dark nerves, pubescent on the outer surface.

Achenes forming a shortly-oblong head, very numerous, small, turgid, sub-stipitate, rounded at the back; beak short, slender, at right angles to the axis of the achene.

Hab. Head of Lake Wakatipu. The species was collected by Mr. A. C. Purdie some years ago.

2. *Lepidium kirkii*, nov. sp.

A very small glabrous species, with entire linear leaves, and long prostrate branching stems.

Rootstock as thick as a crow-quill, subdivided at the crown. Leaves rosulate, entire, narrow-linear, $\frac{1}{2}$in. long or less, the basal part broad, membranous, and sheathing; cauline leaves minute, linear, $\frac{1}{5}$in. long.

Stems several, slender, prostrate, flexuous, branched, sparingly leafy, 2in.–4in. in length.

Flowers perfect, minute, in lax elongating terminal racemes. Sepals small, rounded, green, with scarious edges; petals narrow-linear-spathulate, as long as the sepals; stamens slender, twice the length of the sepals, or less.

Pods on slender pedicels not exceeding their own length, sub-orbicular, but sensibly acute at the apex; apical notch narrow, filled up by the short style.

Hab. Gimmerburn district, Maniototo Plain; 1,100ft.

A most distinct plant. Its small size, prostrate habit, and short linear entire leaves mark it off from all the other native species. It is named in compliment to T. Kirk, Esq., F.L.S., who has published an important paper on the New Zealand species of the genus.

3. *Aciphylla simplex,* nov. sp.

A branched, prostrate species, forming compact patches like *A. dobsoni,* Hook. f.

Stems slender, more or less branched, most densely clothed with simple closely-imbricating leaves.

Leaves 1¾in.–3in. long; the lower half expanded into a thin but stiff sheath ½in. wide; the blade simple, linear-subulate, jointed, semiterete, concave or channelled above, with an ill-defined midrib on the under-surface that frequently projects as a short, blunt, or pungent mucro.

Flowering-stem as stout as the leaves, 1½in.–3in. long, striate, bearing at its top two small leaves like the radical and four or five short densely-capitate umbels of flowers.

Mature achenes not seen.

Hab. Mount Pisa, Mount Cardrona, and Hector Mountains, 6,000ft., on broken rock.

This species is very close to *A. dobsoni,* Hook. f., from which, as well as from all its congeners, it is clearly distinguished by its simple linear-subulate leaves. It flowers in February.

4. *Helichrysum purdiei,* nov. sp.

A much-branched, prostrate, spreading species.

Stems 1½ft.–2ft. long, rigid and woody below, the ultimate twigs wiry, very slender, and clothed with fine loose white tomentum.

Leaves alternate, at intervals of ⅛in.–¼in., uniform in texture and outline, membranous, ¼in.–½in. long, obovate-spathulate, bluntly rounded at the apex and abruptly apiculate; upper surface reticulate and pubescent (in old leaves nearly glabrous); under-surface densely clothed with loosely-appressed greyish-white tomentum concealing the midrib and nerves; the margin recurved.

Inflorescence corymbose, of 3 to 6 small heads, with

slender cottony pedicels and linear bracts (heads occasionally solitary or in pairs).

Outer involucral scales half the length of the innermost, oblong, tomentose, pale yellowish-brown; the two or three inner series with white radiating tips, contracted into a narrow claw, and hardly longer than the florets.

Hab. Dunedin, at Vauxhall and Black Jack's Point. This plant has been repeatedly gathered by Mr. A. C. Purdie, in compliment to whom it is named. It seems to be confined to littoral sloping situations, and has been almost exterminated in its known habitats by the formation of roads and the spread of rank introduced grasses. The small heads and short radiating involucral scales distinguish it from *H. prostratum* (Hook. f.) and *H. keriense* (A. Cunn.).

5. *Gnaphalium paludosum*, nov. sp.

Leaves ½in. long or less; the blade narrow-lanceolate, acute, gradually contracted below into a narrow petiole as long as the blade, one-nerved, glabrous and bright green above, below white with appressed tomentum except the green midrib, recurved.

Stems scapiform, few, when flowering no longer than the leaves, but afterwards elongating to three to five times that length, very slender, white with loose tomentum; bracts few, short, narrow-linear.

Involucral scales in two series, the outer shorter, glabrous, narrow-linear, membranous, very pale green with darker patches at the tips.

Pappus hairs coherent at the base, few, fine.

Achene shortly oblong, pilose with very short stiff hairs. Receptacle deeply pitted.

Hab. Rangipo Plain, North Island, 3,500ft.; Ruahine Mountains, 4,000ft.; Dunstan Mountains (Otago), 3,500ft.; Kyeburn Crossing (Maniototo Plain), 1,100ft.; Hector Mountains, 3,000ft.

This has been hitherto reckoned a form of *Gnaphalium traversii* (Hook. f.). It differs from this in the very slender scape, the small head, the few involucral scales that are darker at the tips, and the glabrous green upper surface of the leaves. Its characters are very constant in all my specimens. The plant is so small as to be easily overlooked.

6. *Agrostis dyeri*, nov. sp.

Culms tufted, erect, rigid, smooth, 6in.–10in. high, the uppermost sheath reaching to the base of the panicle.

Leaves flat, ⅕in. broad or less, the cauline with large green striate sheaths; ligule broadly-oblong, lacerate, variable in length.

Panicle, brownish-green, 1¼in.–4½in. long, contracted, oblong in outline, composed of 5–7 clusters of branches springing alternately from opposite sides of the rachis, the branches similarly divided into a short series of branchlets.

Spikelets $\frac{3}{16}$in. or less.

Empty glumes almost equal, acute, glabrous, green or green tinged with dark-brown, three-nerved, scabrid on the keel. Flowering glume incurved at the edges, broad, truncate, pale, with five distinct greenish nerves produced at the apex into short teeth or points. Palea none.

Hab. Ruahine Mountains (west of Makaretu Bush), 5,000ft.; Tararua Mountains (Buchanan)!; Mount Arnould (Upper Hawea), 3,000ft.–4,000ft. The specimens from Mount Arnould are much smaller in all their parts except the spikelets than those from the mountains of the North Island, but they evidently belong to the same species.

7. *Agrostis tenella*, nov. sp.

Culms not branched or tufted, capillary, wiry, erect, smooth, 7in.–14in. high.

Leaves much shorter than the culms, involute, setaceous, the uppermost sheath not reaching to half the height of the culm; ligule oblong, truncate, lacerate.

Panicle 1½in.–3in. long, spiciform, very slender, of few short capillary branches.

Spikelets $\frac{1}{15}$in. in length.

Empty glumes not spreading, very pale, shining, nearly equal, acute, glabrous, slightly scabrid at the keel. Flowering glume one-fifth shorter than the empty, hyaline, truncate, five-nerved, the nerves delicate and produced to the apex, where they usually project as minute teeth.

Palea, none in my specimens.

Hab. Macrae's, Waihemo County (Otago); 1,800ft.

8. *Triodia australis*, nov. sp.

A short, densely-tufted grass, with procumbent or ascending or erect culms.

Culms leafy below, 2½in.–6in. long, more or less branched at the base.

Leaves involute, almost filiform, deeply striate, as long as the culms or shorter; sheaths broad and deeply grooved; ligule represented by a band of fine hairs which form prominent tufts at the sides.

Panicle small, contracted, of six or fewer short branches bearing 6–12 pale-green, two- or three-flowered spikelets, each about ⅛in. long; pedicels finely pubescent, slender, not longer than the spikelets.

Empty glumes slightly shorter than the spikelet, nearly

equal; the lower obtuse, ovate, coriaceous, 3–7-nerved (usually 3–5-nerved), the nerves disappearing before reaching the transparent membranous margin; the upper similarly 3-nerved.

Flowering glume as broad as long, erose at the truncate top, 9-nerved, the nerves not reaching as far as the scarious transparent edge; palea 2-nerved, nerves ciliate.

Stamens 3, oblong, acute; styles 2, long, openly plumose.

Hab. Mount Ida Ranges, 3,500ft.–4,500ft.; Hector Mountains, 4,500ft.; and Mount Cardrona, 5,000ft. This is not a very characteristic member of the genus *Triodia*, but it seems to have more characters in common with it than with any other genus of grasses at present recognized. The flowering glumes are sometimes distinctly trifid. Its nearest native ally is *T. exigua*, Kirk. It is a nutritious grass, much relished by sheep and horses, and usually closely cropped.

9. *Poa maniototo*, nov. sp.

Culms numerous, filiform, smooth, faintly grooved, 3in. high or less, leafy below, bluish-green when dry.

Leaves very short; sheaths broad, white, membranous, broadly grooved; blade linear, sub-involute or almost terete, glabrous, not striate, with a single groove above, semi-pungent, $\frac{1}{3}$in.–$\frac{3}{4}$in. long.

Ligule rather long, usually divided into two acute projections of the broad sheath.

Panicle small, contracted, of 4–10 large shortly-pedicelled spikelets, each containing 4 or 5 flowers.

Empty glumes unequal, acute, compressed, green with white edges, the upper 3-nerved, the lower 1-nerved, nerves rather faint.

Flowering glumes silky all over, acute, 3-nerved, one nerve medial, two lateral, the latter much less distinct.

Palea 2-nerved, bifid at the apex, the nerves slightly or strongly ciliate.

Hab. Maniototo Plain, Upper Clutha basin, Mounts Pisa and Cardrona; altitudinal range 1,000ft.–4,000ft.

This grass is too small to be of economic value. Its nearest congener is *Poa lindsayi*, Hook. f., from which its larger spikelets and contracted panicles at once distinguish it. It seems to have been hitherto confounded with *Poa exigua*, Hook. f., a species with which it has but little affinity.

Art. LIII.—*Description of a New Species of* Celmisia.

By F. R. Chapman.

[*Read before the Otago Institute, 9th July, 1889.*]

Celmisia brownii.

Plant 9in.–12in. high. Rootstock short.

Leaves 9in. long, oblong, subacute. Greatest width 3½in., falling away, first rapidly, then gradually, towards the petiole. Petiolar part 1½in.–2in. long, broadening to a sheath. Sheath membranous at edges, slightly purple near base on lower side. Petiole and sheath glabrous. Upper surface of leaf glabrous, with here and there a few scattered brown hairs on young leaves grown in winter. Lower side covered with close, short, French-grey tomentum, neither appressed nor woolly, but like velvet or peach-down, with the grain pointing towards the apex of the leaf. Midrib broad, shining, semi-transparent, pale-green, narrowing but still naked to the tip. The naked veins for the major part of their length like threads of light-green running through the tomentum. Viewed from above: Leaf longitudinally divided into about twelve corrugations, as in *C. verbascifolia* and some other species; petiole, and the midrib for half its length, semi-transparent and pale-green, as from below. Leaf obscurely toothed or rough at edges, the roughness being commonly masked by tomentum. Colour of leaf from above, olive-green; from below, between French-grey and green. Leaf not rigid, but rather kid-like to the touch.

Scape, length same as that of leaves, or 2in.–3in. longer. Covered, like leaves, with hairy tomentum, through which it retains its pale-green colour. Very much flattened, and not rigid. Bracts few, and only near the head leafy, 2in.–4in. long, glabrous near sheathing-base, tomentose near tip.

Head 2in. in diameter. Involucral scales numerous, glabrous towards the tip, linear-subulate. Inner scales slightly tomentose. Rays 100, in two series, ¾in. long, $\frac{1}{12}$in. wide. Achene pilose, covered with short bright hairs ⅛in. long. Pappus longer. Corolla-tube pilose, or silky like achene.

Locality. Mystery Pass, Disaster Burn, between Lake Manapouri and Smith Sound; altitude, 3,000ft.–3,500ft.

A single specimen of this plant, one of the finest of the genus, was brought down by Mr. Malcolm Ross, who was a member of the second search-party which went out in December, 1888, to endeavour to ascertain the fate of my lamented friend Professor Mainwaring Brown, in whose memory I have named the species. I have succeeded in grow-

ing the plant in a pot. Though in form this beautiful plant bears a general likeness to *C. verbascifolia*, it differs strikingly in general appearance and in several important characters. As it is here described from a single specimen grown under difficulties, some points may not be found persistent, especially the general olive-green colour, which has modified under cultivation. The height of the scape may differ from that of a naturally-grown specimen.

Art. LIV.—*On the Occurrence of a Variety of* Mitrasacme montana, *Hook. f., in New Zealand.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 12th June, 1889.*]

Plate XXXII.

The herbaceous genus *Mitrasacme* comprises about thirty species, twenty-seven of which are found in Australia, two or three in tropical Asia, and a single endemic species discovered by Mr. J. Buchanan, F.L.S., on the mountains above Dusky Bay. The discovery of a strongly-marked variety of an Australian species in New Zealand is therefore of considerable interest. Some time back I received specimens from Mr. R. Helms, late of Greymouth, which at first sight bore a close resemblance to *Mitrasacme montana*, Hook. f., but presented sufficient points of difference to render them worthy of varietal rank. I propose to distinguish this form as var. *helmsii*. The stems are more imbricating, matted, and more depressed than in the type. It may be characterized as under:—

Mitrasacme montana, Hook. f., var. *helmsii*.

A small herbaceous perennial, forming depressed matted patches. Stems slender, 1¼in.–2in. high; leaves opposite, obovate, glabrous, narrowed into very short flattened petioles, or sessile. Flowers invariably terminal, nearly sessile; calyx 4-partite, segments linear, shorter than the corolla, acute or obtuse, persistent in fruit; corolla tubular, slightly contracted at the mouth, lobes short, acute; ovary rounded, styles erect, connivent, slender. Capsule small, nearly or quite sessile, mouth compressed, the outer angles produced into lateral curved filiform processes.

Hab. South Island—Paparoa Ranges, Westland; 3,000ft. *R. Helms.*

This differs from the typical form in the more densely matted habit, the longer calyx, in the peduncles being absent, or never elongated even in fruit, and in having the compressed fruits produced into curved lateral filiform processes. The flowers are of a delicate fawn colour.

The typical form occurs in Tasmania and Victoria.

EXPLANATION OF PLATE XXXII.

Mitrasacme montana, Hook. f., var. *helmsii.*

Fig. 1. Flowering specimen, natural size.
Fig. 2. Leaves, enlarged.
Fig. 3. Flower, enlarged.
Fig. 4. Calyx, enlarged.
Fig. 5. Corolla, enlarged.
Fig. 6. Corolla laid open to show the stamens, enlarged.
Fig. 7. Pistil, enlarged.
Fig. 8. Fruit, natural size.
Fig. 9. „ enlarged.

Art. LV.—*Description of a New Species of* Chenopodium—C. buchanani.

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 12th June, 1889.*]

Plate XXXII.

This remarkable plant was discovered so far back as 1868 by Mr. J. Buchanan in Port Nicholson, where it is restricted to a single habitat. In the absence of female flowers it was doubtfully referred to *C. triandrum*, Forster, and subsequently to *C. pusillum*, Hook. f. About eight or nine years ago I received specimens of the same plant from Mr. D. Petrie, who collected them on the Maniototo Plains; subsequently I had the good fortune to discover the plant in two other localities: but until recently the female flowers remained undetected. It is usually restricted to a very limited area in each locality, and occurs in situations where it is exposed to the influence of the sea-spray; but to both these peculiarities there is a notable exception, which requires special mention. On the Maniototo Plains I found it growing at a distance of eighty miles from the sea and an elevation of 1,800ft., extending in vast profusion for many miles, although with occasional breaks, its habitat being a whitish clay strongly impregnated with saline matter. Wherever this bed is exposed the *Chenopodium* is abundant, associated with other plants usually restricted to littoral situations.

This species forms depressed white or greyish patches, which are easily recognized at a considerable distance owing to the mealy tomentum with which the plant is covered. The stems are excessively branched, the branches being stiff and wiry, especially when dry. The flowers are extremely minute: the female, being much smaller than the male, are necessarily inconspicuous; but this is not the only cause of their having escaped notice so long: the female perianth is developed on the lower parts of the branches; it is of the same consistence as the farinose leaves, and so closely resembles the tip of an impoverished branchlet springing from the axil of a leaf that its true nature is only shown by the extremely minute stigmas, which, being extremely delicate and fragile, are easily overlooked, even by a good observer. All traces of the stigma disappear in badly-dried specimens, and it is not an easy matter to detect the female flowers on good specimens, even when they are freely developed. The yellow anthers of the male flowers, which are produced near the tips of the branches, attract attention even on a cursory examination.

It affords me great pleasure to connect the name of its original discover, Mr. J. Buchanan, F.L.S., with this interesting species.

Chenopodium buchanani.

An annual monœcious herb clothed with farinose tomentum. Stems prostrate or sub-erect, 1in.–3in. high, excessively branched, branches wiry. Leaves opposite or alternate, sessile or sub-sessile, $\frac{1}{8}$in.–$\frac{1}{4}$in. long, entire, ovate, or ovate-oblong, or nearly orbicular. Flowers axillary, solitary—male, near the tips of the branches, perianth membranous, shortly peduncled, minutely papillose, 5-cleft, tips of segments incurved, stamens 5, exserted; female, on the lower parts of the branches, $\frac{1}{20}$in. long, sessile, perianth urceolate, farinose, 2-lipped, stigmas 2. Seed rounded, much compressed, puncticulate, adhering to the utricle.

Hab. New Zealand. North Island: Port Nicholson; J. Buchanan, T. Kirk. South Island: The Brothers Rocks, Nelson; C. Robson! Maniototo Plains (1,800ft.); D. Petrie, T. Kirk. Centre Island, Foveaux Strait; T. Kirk.

DESCRIPTION OF PLATE XXXII.

Chenopodium buchanani.

Fig. 1. Young plant, natural size.
Fig. 2. Staminate flower, natural size and enlarged.
Fig. 3. Pistillate flower, natural size and enlarged.
Fig. 4. Pistil, slightly enlarged.
Fig. 5. Seed, natural size and enlarged.
Fig. 6. „ side view, enlarged.

Art. LVI.—*Notice of the Discovery of* Asplenium japonicum, *a Fern new to the New Zealand Flora.*

By T. F. Cheeseman, F.L.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 19th August, 1889.*]

So many people take an interest in the ferns of New Zealand, either as collectors or cultivators, that no apology is needed for bringing the discovery of an additional species under the notice of the Institute. Rather more than a year ago Miss Clarke, of Waimate, Bay of Islands, sent for my examination a parcel of specimens of a fern new to her, and which she believed to be new to New Zealand. In this she was perfectly correct, the fern proving to be *Asplenium japonicum*, a species common enough in many tropical and subtropical countries, but not previously known from New Zealand proper, although in August, 1889, I gathered specimens in a locality as near to us as the Kermadec Islands.

Through the kindness of the Rev. Philip Walsh, of Waimate, Bay of Islands, I have obtained some information respecting the locality in which the fern was found. It formed a patch about 40ft. square in some damp and stony ground on the banks of the Okura River, a branch of the Kerikeri River. The vegetation in the immediate vicinity was chiefly composed of tall tea-tree (*Leptospermum*), and no plants of any special interest besides the *Asplenium* were noticed. The neighbourhood was searched for some distance, but no additional specimens were observed.

Asplenium japonicum belongs to the sub-genus *Diplazium*, hitherto believed to have no representatives in New Zealand. None of the specimens sent to me by Miss Clarke exceeds 18in. in height, and most of them are much smaller. In colour and texture there is some resemblance to *Asplenium umbrosum*, but that is a much larger fern, with a differently-divided frond. It is quite unlike all the other New Zealand species, and will be recognized with ease should it be found in other localities in the north of the colony, as is not improbable. The following description is drawn up from Miss Clarke's specimens :—

Rhizome slender, apparently long and creeping. Stipes slender, pale, with a few chaffy scales at its base, 4in.–8in. long. Frond 6in.–9in. long, 3in.–5in. broad, ovate-lanceolate, pinnate at the base, pinnatifid towards the top; pinnæ $\frac{3}{4}$in. broad, cut down nearly to the rachis in the lower part; lobes oblong, rounded, toothed; texture herbaceous. Veins 3–6 to a lobe on each side, usually all soriferous. Sori occasionally diplazoid.

Originally discovered in Japan, hence its name of *japonicum.* It has since been found to be widely spread through Eastern Asia, ranging from Japan and China to India and Malacca. It also occurs in several of the islands of the Malay Archipelago, in New Guinea, and has been recorded from Fiji and Samoa and others of the Polynesian islands.

ART. LVII.—*A Description of Two Newly-discovered Indigenous Cryptogamic Plants.*

By W. COLENSO, F.R.S., F.L.S., &c.

[*Read before the Hawke's Bay Philosophical Institute, 8th July, 1889.*]

Isoëtes, Linn.

1. *I. multangularis*, sp. nov.

Root a tuber as big as a small marble, orbicular in outline, sub-conical, 8–9 lines long, 6–7 lines diameter, multangular, deeply furrowed, covered with a dense coating of fine dark-brown hairs; a cross-section shows 5–6 broadly-obovate and nearly regular pure-white knobs (or lobes), their sinuses each 2–3 lines deep, with a minute central pith-like ring (*primâ facie* reminding of a small primrose corolla). Rootlets many, very long—3in.–5in., filiform, mostly simple, brown. Leaves numerous, 15–20 and upwards, 6in.–7in. long, erect, linear, very acuminate, sub-rigid, brittle, glabrous, glossy, minutely and clearly marked in quadrilateral divisions, the upper portion light-green, the lower white, semi-terete on the under and slightly flattened on the upper surface, regularly septate in 4 alternate longitudinal divisions as if composed of 4 rows, tips terete filiform, apex obtuse, breadth at middle $\frac{1}{15}$in., the lower portion for 1in.–$1\frac{1}{2}$in. canaliculate with the margins membranous and gradually conniving, decreasing upwards, the basal portion for about 1in. dilated to nearly 3 lines in breadth. Below the leaves on the outside are broadly elliptic light-brown transparent scales with a thickened dark centre and very finely reticulated, their margins irregularly lacerate and tip apiculate. Sporangium ovoid, sides straight, sub 2 lines long and 1 line wide. Macrospores of various shapes, some hemispherical, others globoso-tetrahedric like segments of spheres, usually smooth, a few only having 2 or 3 minute points; and also varying in size from $\frac{1}{50}$ in. to $\frac{1}{80}$in. diameter Microspores very minute, globular and sub-elliptic, hyaline, $\frac{1}{8000}$in.–$\frac{1}{2000}$in. diameter.

To this I append with very great pleasure the interesting and valuable detailed microscopical examination of the sporangia and their contents kindly and purposely made for me by my friend Dr. Spencer, with the aid of his powerful microscope; who thus writes: "I have had another hour with the pretty little *Isoëtes*. 1st. The sporangium at the base of the leaf is an ovoid body, slightly flattened at the sides, $\frac{1}{8}$in. long by $\frac{1}{12}$in. broad; in some cases with a Y-mark at the end as though this were the shape of the opening when ripe. Within this are the macrospores. Out of one of the sporangia, which I divided, I counted twenty of these bodies. They vary in size from $\frac{1}{50}$in. to $\frac{1}{70}$in. in diameter; a few are even smaller than this. They are not uniform in shape, but for the most part give the idea of being segments of spheres; some are hemispherical, others, and by far the larger number, have the appearance of hemispheres either divided into four parts or their inner sides flattened by mutual compression into a solid triangle with one face forming a segment of a sphere. You may get an idea of the shape by dividing an apple or potato into halves, then laying one half on its flat face, dividing it again into four by a crucial incision. Each of these bodies is composed of three tunics; the outer semi-transparent, membranous, brownish in colour, showing ridges and furrows, which seem to result from pressure on the middle coat. The middle coat is white, thick and ridged along the margins, with the facet sculptured into figures of various shapes. Under the microscope the effect is very beautiful, and the original must be seen to appreciate it. The innermost coat is also white, but smooth. Within it are the microspores, minute spherical or ovoid bodies $\frac{1}{3000}$in.–$\frac{1}{2000}$in. in diameter, pellucid, having much the appearance of starch-grains or oil-globules. I put on the polariscope, but they did not respond, and therefore are not the former; and I washed them with ether, but they did not disappear, and therefore they are not the latter. The effect of the latter operation was to make the contour much more distinct, and also to relieve it of a brownish coloration, so that I am disposed to think they must have been surrounded by or contained some oily matter. They are very numerous."

Hab. "In sheltered bays, Lake Taupo, in 2ft.–10ft. water with sandy bottom." *Mr. C. J. Norton,* June, 1889.

Obs. I. The examination, &c., of this little plant has occupied no small amount of both time and labour, with also the scattered necessary references; partly, however, owing to the fact of the lot I had received from Mr. Norton arriving in a much damaged state, being mostly beached specimens of plants torn up and cast on shore in a furious gale. It was pretty apparent, notwithstanding, that they differed from our other (described) New Zealand species, as also, on fuller

examination, from known foreign ones, which will be found from the description.

II. This species differs from *I. lacustris,* Linn., of the British lakes (probably also cosmopolitan), in its peculiarly-formed thick tuberous root with its hyaline scales, its longer and narrower and differently-constructed leaves, and more slender sporangia. In its tuberous root it slightly resembles *I. duriæi,* Bory (a French species, but lately found also in the Island of Guernsey), and also *I. hystrix,* Durieu (an Algerian species), but it is a much larger plant than either, with very different leaves, &c., and its root also wants the peculiar rigid, trifid, and pungent scales of *I. duriæi,* and the long, black incurved spines of *I. hystrix.*

III. Preserving some of their roots, I cleaned and placed them in a clear glass vase, covering them with water. They soon sprouted fresh leaves, and have grown nicely, with many young plants as fine as hairs springing from their sporangia.

Order VIII. FUNGI.

Genus 27.* **Geaster,** Micheli.

1. *G. coriaceus,* sp. nov.

Outer peridium $4\frac{1}{2}$in. diameter, expanded, broadly hemispherical at base, very thick—sub 2 lines or more, leathery, tough, firm and rigid when dry, divided about half-way down into 5 pretty equal broadly-triangular acute spreading segments, their tips very distant, each 1in. wide at base, much recurved and deeply transversely fissured creased and wrinkled above at base, their fissures, &c., of a pale colour, dark blackish-brown rough and much reticulated on the outside, smooth and somewhat shiny and light-brown on the inside, with a continuous thick border at their inner bases raised all round much above the inner peridium, the large hemispherical sac or cup being $1\frac{3}{4}$in. diameter, and fully $\frac{3}{4}$in. deep; *inner peridium* $1\frac{1}{4}$in. diameter, globular, thin, papery, somewhat smooth but not shiny (under a lens very slightly but evenly roughish, as if finely felted), sessile, the junction being small, very free all round, dark-brown, having a depressed coronula 4 lines diameter, with its centre raised and of a lighter brown, the ostiole large—$1\frac{1}{2}$ lines diameter, gaping, margins irregular, incurved, thickly silky and sub-ciliate. Spores very minute, spherical, "$\frac{1}{8000}$in. diameter, studded with minute processes; under the microscope are numerous puncta, evidently the places where the processes are attached on the flattened surface" (Dr. Spencer, *in lit.*).

Hab. On the ground at Tangoio, near Napier; 1889: *Mr. A. Hamilton.*

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* The number of this genus in Hooker's "Handbook N.Z. Flora."

Obs. A fine species, having some slight affinity with our other described indigenous ones (most so, perhaps, with *G. coronatus*, Col., "Trans. N.Z. Inst.," vol. xvi., p. 362); also with those of Tasmania and Australia; but it is very distinct from them all. I have received several specimens, and they generally agree in size, form, cuttings, and markings. This is by far the largest indigenous species known to me in a *perfect* state; but I have found at various times, in travelling, deposited on both river-mouth- and sea-beaches, the detached outer peridium of a much larger and coarser species, but could never meet with a perfect specimen.

Art. LVIII.—*A Description of some Newly-discovered Indigenous Cryptogamic Plants.*

By W. Colenso, F.R.S., F.L.S., &c.

[*Read before the Hawke's Bay Philosophical Institute, 7th October, 1889.*]

Class III. CRYPTOGAMIA.

Order I. Filices.

Genus 18.* **Asplenium**, Linn.

1. *A. ornatum*, sp. nov.

Plant tufted; caudex short sub 1in. high, very scaly; scales black, 4–5 lines long, subulate, very acuminate, tips flexuous, with a few minute scattered weak sub-ciliate-like lateral lobes, cancellate, sub 20 cells wide at base; cells parallelogrammic, irregular, their walls very thick and coarse; few-fronded (4–6), sub-erect, membranaceous, flaccid, drooping, dark-green, 11in.–13in. high, thickly scaly throughout on stipe, rhachises, and petioles with blackish veined scales, similar to basal ones but much smaller. Stipe very slender, 4in.–5in. long, about $\frac{1}{10}$in. wide, dryish, striate, deeply sulcate, pale greyish-green. Frond 6in.–8in. long, oblong-lanceolate (sometimes broadly ovate), sub-tri-pinnate, glabrous; pinnæ alternate, distant on main rhachis 1in. apart, 4in. long; pinnules very distant on secondary rhachises sub $\frac{1}{2}$in. apart, with long capillary petiolules 3–4 lines long, usually oblong-lanceolate, 4–5 lines long, with narrow thickened white margins, the upper half sharply toothed sub-laciniate and narrow-lobed, sometimes cut into 3 segments with their tips sharply toothed-laciniate, the middle segment narrow rhombic-cuneate, the two outer ones linear and petiolulate; veins few, narrow, sub-flabelliform, simple rarely once-forked, thickened

* The numbers in this paper attached to both orders and genera are those of "The Handbook of the New Zealand Flora."

(lanceolate shape) at apices, and there very prominent on the upper surface, not extending to margin. Involucre very membranous, intramarginal, 2 (sometimes 3) on the larger segments, only 1 on the smaller ones, narrow-linear sub 2 lines long, ends sub-acute. Sori light reddish-brown, largely appearing.

Hab. On dry hilly ground at Kuripapango, County of Hawke's Bay; 1889: *Mr. Pinckney.*

Obs. It is not without some hesitation, and only after a long and protracted examination, that I advance this fern as a *sp. nov.*, for certainly it is pretty closely allied to *A. hookerianum*, mihi (var. *adiantoides*, Raoul); but it differs from that fern in several characters, which, moreover, are constant in all the specimens I have seen. *A. hookerianum* in all its forms (whether the larger var. figured by Raoul, "Choix de Plantes de la Nouvelle-Zélande," pl. i.,—or the smaller ones figured by Hooker, "Icones Plantarum," vol. x., tab. 983) has very broad segments, thus described by Raoul: "flabellato-rotundatis crenatis" (*l.c.*); by J. D. Hooker, "rhombeo-subrotund," "Handbook N.Z. Flora," p. 373; and by Baker, "rounded and crenate," "Synopsis Filicum," p. 213,—who also says, "the pinnæ and pinnules in shape resemble those of *Asplenium ruta-muraria*," which characters, however, are not in this plant. The narrow sharply-toothed segments of this fern are also margined white with peculiar apical terminations to their veins, which are also very conspicuous and more simple; the large basal scales are without the clear intramarginal continuous line so striking in *A. hookerianum*, and are irregularly and coarsely cancellate; while the very long capillary and distant petiolules, together with their narrow segments, give this fern a light, airy, and graceful appearance, which is also very attractive.

2. *A. gracillimum*, sp. nov.

Plant tufted; caudex short, composed of coalescent stipites, very scaly; scales membranaceous, softish, shining, subulate, ½in. long, 2 lines broad at base, cells there sub 40 wide, more sub-ciliate with smaller and narrower cells than in *A. ornatum* (*supra*). Fronds 8–10, erect, drooping, 12in.–14in. high, membranous, soft, flaccid, glabrous, darkish-green. Stipe 4in.–5in. long, slender, pale, dryish, sulcated, densely scaly; scales persistent, red-brown, of various sizes. Frond 8in.–9in. long, oblong-ovate, tripinnate, rhachises and petioles of pinnules scaly; pinnæ alternate, regular, distant (1in.–1½in. apart on main rhachis), 3in. long at middle of frond, the 3 lower pairs slightly decreasing in size; pinnules distant, petiolate; petioles slender, rather long, decurrent to next pinnule (sub-pinnatifid), margin thickened; the basal pin-

nules usually containing 5 segments, their sides entire, bases cuneate excised; tips largely toothed or sub-lobed, each lobe containing a single sorus, but 2 on the larger lower lobes; veins few, somewhat sub-flabellate and simple, not extending to margin, their tips thickened. Sori sub-marginal, situated on the inner vein of segment. Involucre small, 1 line long, linear-oblong, very membranous, transparent, filled with numerous closely-crinkled veinlets having double walls; margin crenulate.

Hab. Dry sides of hills, shady woods south of Dannevirke, County of Waipawa (where it is plentiful); 1888, 1889: *W. C.*

Obs. A very symmetrical neat species, differing considerably from other known New Zealand species of this genus, though approaching the preceding one (*A. ornatum*), and also *A. hookerianum*, var. *adiantoides;* and somewhat distantly resembling small specimens of *A. bulbiferum*, but very dissimilar from that plant in texture, colour, and dense persistent scales, in its slender and dry stipes, its narrower and more distant stipitate segments, which are also laciniate-lobed, &c., and in the position of its sori, with their peculiarly-veined involucres.

Order V. Hepaticæ.

Genus 7. **Gottschea**, Nees.

1. *G. clandestina*, sp. nov.

Plant small, ¾in.–1in. high, 3–4 lines wide at top, sub-obovate tapering, sub-erect, scattered; stems simple, white, succulent, glossy, the smaller specimens leafy to base, the larger ones with numerous dark-purple rootlets on their lower half; leaves ovate-dimidiate, with 2 small plaits at each apical margin; anterior margin laciniate-serrate, the basal half largely so; posterior margin almost entire, with 3 (or 4) distant minute teeth; the lower leaves distant, smaller and sub-falcate, their tips rounded entire; the upper leaves imbricated, sub-acute, their tips finely serrate; dorsal lobe two-thirds length of leaf, its anterior margin entire rounded and produced beyond leaf, the lower margin straight, at some distance within that of leaf, its junction-ridge thickened, produced, serrulate; tip truncate, entire. Stipule large for plant, broadly elliptic, 1¼ lines long, margined, bifid, each lobe largely trifid at top, with 1–2 coarse teeth on each side; laciniæ large, irregular, margins sinuate, acute not ciliate; sinus long, narrow, irregular, with 2 teeth at bottom near base, 1 on each side. Cells large, sub-quadrate-orbicular, irregular, distant, not clear, filled, guttulate and many-beaded.

Hab. Scattered among dense patches of *Aneura polymorpha*, Col. (*infra*), low wet woods south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. A very neat little species, allied to *G. marginata*, Col. ("Trans. N.Z. Inst.," vol. xviii., p. 241), but differing in several characters. Its place and manner of growth, nearly hidden among the close-growing and erect *Aneura*, is peculiar; and it is not easily detected.

Genus 8. **Chiloscyphus**, Corda.

1. *C. involucrata*, sp. nov.

Plant creeping, 2in.–3in. long, 1–1¼ lines broad, symmetrical, regular, distantly branched; light-green. Branches very few, alternate, divergent, simple rarely sinuate, rooting largely at stipules; roots long, tubular, white, hyaline. Leaves numerous, very close throughout, densely imbricate, decurrent, broadly ovate-deltoid with apex truncate; margins sub-sinuate; tips 2-horned, a horn at each extreme angle, long, divergent, broad, 4-celled transversely at base, the upper horn usually longer; sinus deep, sides sinuate, the centre (at base) notched. Cells large, orbicular with beaded centres, and minute triangular intermediate cellules; cell-walls stout, conspicuous. Stipules large, extending across stem, connate with leaves below, 4-fid, each of the two inner lobes having a small lobule or tooth on its outer margin. Fruit terminal on a short basal branch; sometimes two such branches are near each other on the same side of stem. Involucral leaves large, connate, spreading, and (with perianth) darker green, their tips laciniate; laciniæ long, flexuous. Fruit-stalk slender, erect, ½in. long; capsule small, elliptic, blackish.

Hab. Rooting, mostly hidden, among, and epiphytal on, small cæspitose *Aneura polymorpha*, Col. (*infra*), on rotten logs, low wet woods south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. A neat species, pretty closely allied to *C. spruceana*, Col. ("Trans. N.Z. Inst.," vol. xxi., p. 59).

Genus 13. **Lepidozia**, Nees.

1. *L. retrusa*, sp. nov.

Plant small, single, sub-erect, 1in. high (rarely above, mostly under), 3–6 lines wide; main stem brownish; cells parallelogrammic, pinnate (very rarely bipinnate), branches alternate, distant, tips flagellate; flagellæ long, capillary, flexuous, pale, with small scattered bundles of long white hyaline rootlets. Leaves numerous close imbricate concave, pale-green their margins darker green, sub-quadrate, 4-fid; lobes extending one-third of leaf, broad, triangular, divergent; margins slightly sub-sinuate; sinuses wide; cells distinct, sub-quadrate-orbicular, regular in size, guttulate, obscure. Stipules rather distant, small, broadly ovate; tips slightly 2–3-toothed; cells

connected, regular, clear, parallelogrammic; walls narrow, black. Fruit at base of branch near middle of main stem, solitary, rarely 2 on a plant, and when so then near each other. Involucral leaves adpressed, broadly elliptic, nearly entire, their tips mucronulate. Perianth white, oblong, 1 line long, sub-acute, plaited, tip slightly toothed; cells as in stipule. Capsule narrow-oblong, tip obtuse, base truncate broader than fruit-stalk; elaters nearly straight, closely twisted, ends obtuse.

Hab. On rotten logs, completely hidden among patches of *Aneura polymorpha*, Col. (*infra*), low wet woods south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. This is a neat little species; the great regularity of its concave leaves, with their coloured margins, give it a pleasing and striking as well as distinct appearance. Its affinities, however, are with small specimens of *L. capilligera*, Lindb., and *L. lævifolia*, Hook. f., and also *L. minuta*, Col. ("Trans. N.Z. Inst.," vol. xviii., p. 245).

2. *L. occulta*, sp. nov.

Plant small, very slender, prostrate, lanceolate, pinnate, main stem 1½in.–2in. long, 4–5 lines wide at middle, much and very closely branched; branches opposite and alternate, usually short, simple rarely pinnate, decreasing gradually in length towards apex and base. Leaves and stipules close, spreading, 3-fid to base, their lobes long setaceous, usually 5-jointed; tips sub-imbricate, finely capillary, flexuous. Fruit sub-sessile on main stem at base, also about the middle. Involucral leaves adpressed, sub 3 rows, tips laciniate; laciniæ narrow, their tips obtuse. Perianth large for plant, darkish-green, linear-ovate, 2 lines long, slightly curved, tip acuminate sub-acute, laciniate and ciliate; cells long, narrow, parallelogrammic.

Hab. Rooting concealed (with preceding species, *L. retrusa*) among patches of *Aneura polymorpha* (*infra*), low wet woods south of Dannevirke; 1889: *W. C.*

Obs. A distinct neat little species; in general appearance approaching small plants of *L. capilligera*, Lindb., and *L. lindenbergii*, Gottsche.

Genus 32. **Aneura**, Dumort.

1. *A. perpusilla*, sp. nov.

Plant very small, dark emerald-green, of densely-compact growth; main stem horizontal, creeping, closely appressed and thickly rooted, 3–4 lines long, $\frac{1}{25}$in. wide, bipinnatifid; branches (fronds) 1½ lines long, erect, closely compacted, 3–5-fid (usually 3-fid at tip), segments about one line long, linear-subulate, obtuse, incurved. Fruit at base of frond,

usually solitary, sometimes two together. Involucre minute, very shallow, irregularly and distantly toothed; teeth acute. Calyptra 1½ lines long (nearly as high as frond), white, glabrous, cylindrical, erect, obtuse; tip urceolate. Seta 3 lines long, white, hyaline, glossy. Capsule narrow-oblong, brown; valves narrow-linear, striate, sub-acute; elaters brown, forming large pencilled masses at tips.

Hab. On very rotten wet logs, low woods south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. A curious minute species, forming extensive patches completely covering the surface of log, and somewhat resembling coarse green plush. It is allied to *A. muscoides*, Col. ("Trans. N.Z. Inst.," vol. xviii., p. 251), but is very distinct.

2. *A. polymorpha*, sp. nov.

Plant of densely-cæspitose growth, firm, somewhat brittle, bright emerald-green; roots brownish, thickish, succulent. irregular, spreading; fronds erect, of nearly uniform height in appearance, 6–9 lines high, ½ line to 2 rarely 3 (usually 1½) lines wide, of various shapes and sizes, simple narrow-linear cuneate and oblong-obovate, two-branched from base, subpalmate and flabelliform with 3–5 branchlets; branchlets irregular and spreading, subpinnatifid, margins distantly and slightly incised, sinuate, sub-crenately knobbed and notched, tips incurved, always broader and crenulate. Cells numerous, small, oblong-lanceolate, each having a free central oblong dot. Fruit usually single at base of frond, sometimes 2, rarely 3–4, together, yet, in one specimen, 7 near each other. Involucre short, pubescent, margin sharply sub-serrulate. Calyptra cylindrical, erect, 2 lines long, white minutely speckled, puberulent, the tips slightly produced and ragged; hairs light reddish-brown. Seta 9–12 lines long, slender, curved, shining, hyaline, striate, multi-septate and closely so at top. Capsule narrow-oblong; valves linear-oblong, subacute and submucronulate, dark-brown, darker at tip and at base, margined, thickly striate, with dark linear dots in regular lines between striæ. Elaters closely twisted, tips very acuminate, acute.

Hab. On rotten logs, low wet woods south of Dannevirke, with preceding species (*A. perpusilla*), but forming separate patches; 1889: *W. C.*

Obs. This plant forms large spreading patches, very closely growing like a short moss, covering the whole surface of the log. It changes its colour soon after removal, even when kept alive in water. It has intermixed with it two minute species of sub-erect *Lepidoziæ*, which are always lower than the *Aneura*, and are not found without breaking it up—*L. retrusa*, and *L. occulta*, Col. (*supra*).

Order VIII. Fungi.

Genus 60. **Peziza**, Dillenius.

(§ Lachnea.)

1. *P.* (*L.*) *spencerii*, sp. nov.

Gregarious, often sub-coalescent and adhering at base in small clusters, partly imbedded in the soil, and fixed by the centre and by a few small divergent rootlets. Cup sessile, of various shapes and sizes, usually more or less globular depressed, $\frac{1}{2}$in.–$1\frac{1}{2}$in. diameter, urceolate, at first nearly closed, afterward opening circularly, and often becoming explanate, breaking into several irregular and large ragged lobes; thickish, fleshy, somewhat brittle; margin thin, slightly and irregularly lacerate and toothed, recurved: *outwardly* dirty-white inclining to a lightish-brown, roughish, deeply wrinkled below; wrinkles smooth, sub-radiating from the centre, slightly yet thickly puberulent in depressions, particularly about the base; hairs white: *inwardly* light reddish-brown, very largely wrinkled yet smooth; ascus broadly linear, cylindrical, regular, $\frac{1}{1300}$in., containing 8 sporidia; sporidia elliptic, free, distinct, obliquely posited, $\frac{1}{1200}$in.; nucleus (apparently) single, as in some other of our described New Zealand species, or 0; paraphyses slender, $\frac{1}{4000}$in., 3-septate at top.

Hab. On the bare ground in the garden of W. I. Spencer, Esq., F.L.S., Scinde Island, Napier; Sept., 1889.

Obs. I. This is the largest species of *Peziza* yet found in New Zealand. It has a very striking appearance when fresh, and grew pretty plentifully in one spot of a few square yards. Dr. Spencer (to whom I am again indebted both for specimens and the accurate microscopical measurements given above) informs me that, though plentiful, he had only noticed them in that part of his garden which had lately received a quantity of fresh stable-manure; and also, "with respect to the nuclei, mine show no nucleus, but a quantity of granular matter; they also exhibit a very distinct *hilum*, with faint concentric elliptical lines, not unlike what is seen in starch-grains; however, they do not polarize light, so they are not starch-granules: others are filled with fine granular matter, and do not show the *hilum*. I examined sporidia not only in the asci, but also many that had been extruded, and which I therefore presumed to be mature. It would be interesting to know whether these intercellular bodies ever make their appearance, and, if so, at what stage." (Dr. Spencer, *in lit.*)

II. While my specimens were drying I observed, on my placing them in strong sunlight, that their sporidia were ejected in cloudy puffs, with apparently elastic force, and this was caused by the least agitation in carefully removing them.

ART. LIX.—*A Description of some Newly-discovered Phænogamic Plants, being a Further Contribution towards the making-known the Botany of New Zealand.*

By WILLIAM COLENSO, F.R.S., F.L.S., &c.

[*Read before the Hawke's Bay Philosophical Institute, 13th May and 7th October, 1889.*]

THE plants contained in those two papers are here placed together systematically, so as to avoid repetition of orders and genera. Those described early (in May), in the first paper, were all from the mountainous interior, East Taupo County, and collected by Mr. Hill; while those in the later paper (in October) were mainly from the lowland forest region near Dannevirke, collected by W. Colenso and by Mr. A. Hamilton, and also from near the sea on the East Coast.

Order XXII. LEGUMINOSÆ.

Genus 1.* **Carmichælia**, Br.

1. *C. orbiculata*, sp. nov.

A very small erect rigid shrub of 2in.–3in. high, whose main stems are prostrate and under soil (and ever-shifting volcanic sand), much and closely branched, forming large flat patches somewhat resembling a coarse doormat; branchlets ¾in.–1in. long, erect, rigid, simple, linear, flat, 2 lines wide, coarsely but regularly striate, yellow-green, their tips very obtuse, dark-yellow with blackish (ustulate) margins, their lateral margins irregularly and distantly notched, each notch having a scarious light-brown ciliated appressed triangular bract. Flowers in small sub-corymbose panicles usually 3–5 together; peduncle rather long and (with pedicels) slightly pilose, each pedicel decurved, with 1–2 small ovate brown bracteoles, their margins pilose-ciliate. Calyx rather large, green, cup-shaped, inflated, with 5 acute blackish teeth, the sinuses large rounded. Corolla pinkish-lilac; standard orbicular, slightly emarginate, 2 lines diameter, much veined. Anthers connate nearly to tips. Stigma sharply papillose. Pod green, glabrous, slightly rugulose, orbicular sometimes broadly elliptic, 3 lines diameter; beak long, slender, very much recurved; replum stout; 1-seeded. Seed orbicular-cordate, sides unequal, dull-green spotted with purple.

Hab. Desert of Rangipo, near Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

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* The numbers attached to the orders and genera in this paper are those of them in the "Handbook, Flora of New Zealand."

Obs. A very interesting little species, in size and habit of growth allied to *C. nana*, Col., from the same mountainous locality; but widely different from that species in several important characters. Its very peculiarly-shaped and unique pod distinguishes it from all its known congeners.

Order XXVI. Droseraceæ.

Genus 1. **Drosera**, Linn.

1. *D. polyneura*, sp. nov.

Plant, small somewhat tufted, erect, 1in.–2½in. high; rootstock woody, thickish, vertical, 1in.–2in. long, black, with many irregular spreading wiry rootlets below; sometimes two plants arise from one stock, each bearing 1–3 flowers and 3–7 leaves. Leaves of two forms, their upper surfaces above the middle and their margins glandular; glands not crowded, flat, long and patent at margins, the single apical one more than two lines long, very short on lamina, their tips elliptic, smooth, dark-red; the outer leaves narrow oblong-ovate spreading, usually deflexed from junction with petiole, 1in.–1½in. long, 4 lines wide, many-nerved, tip very obtuse rounded, base tapering; petiole very broad, sub 3 lines, 5-nerved, conduplicate, clasping; the inner leaves longer, linear, 1½ lines wide, erect. Scape erect, 1½in.–2in. long, shorter or longer than leaves, 1-flowered, with a long linear basal leaf (or bract) ¾in.–1in. long, glabrous, eglandular, margins closely incurved, tip obtuse, and a minute linear bracteole near the top of scape. Calyx-lobes no tcut to base, sub-oblong-obovate, 3-nerved, tips obtuse, toothed. Corolla 4 lines diameter, scarcely longer than calyx, not spreading, pale yellowish-white, very membranous; petals narrow obovate, tips slightly obtuse, margins irregular, 3-veined, veins dark, branching. Stamens 5, much shorter than corolla; filaments flat, 1-nerved; anthers orbicular, bright-yellow, perigynous between petals. Styles 4, each nearly 1 line long, thick, spreading; stigmas large, globose, fimbriate; fimbriæ branched, their tips globular. Ovary narrow oblong-obovate, black, shining, 3-valved, minutely papillose, much longer than corolla.

Hab. Swampy spots, base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. I. At first sight, and without close examination, this little plant may easily be taken for its near ally *D. arcturi*, Hook., which it much resembles; but it possesses many grave and different characters—in its two forms of leaves, its scape-bracts, its smaller membranous flowers with differently-shaped lobes to both calyx and corolla, and its 4 separate styles.

II. The description of *D. arcturi* in the "Flora N.Z.," and in the "Handbook, Flora N.Z.," differs pretty considerably from the typical description, with its drawings and dissections, of that Tasmanian plant: fortunately I possess them all, and from them I here append some of its peculiar specific characters, in order to show the great difference between these two species.

III. *Drosera arcturi* was first briefly described by Sir W. J. Hooker in 1834, in his "Journal of Botany," where he also observes, "The flower of this very fine species is as large as that of *D. binata*." Three years after, in 1837, in vol. i. of his "Icones Plantarum," tab. lvi., Sir W. J. Hooker gives a drawing of this plant, with dissections; where he also repeats what he had formerly said respecting it, adding, "The *large* solitary flower will at once distinguish it from every other species." In the drawings given the calyx-lobes are narrow, sub-acute, regular, and cut to base; the corolla very much larger, with the tips of its large lobes rounded, and their scapes twice the length of its leaves, which are also only of one form ("linear-spathulate").

IV. Sir J. D. Hooker, also, in his "Flora Tasmaniæ," similarly describes this species, but much more fully: he says, "Foliis linearibus . . . . sepalis lineari-oblongis, obtusis, ... petalis erectis coriaceis lineari-spathulatis obtusis, coriaceis, ... stylis 3 indivisis." And again (in English), "A most distinct and beautiful species, 3in. to a span high; . . . . leaves 2in.–6in. long. . . . . 1-nerved, covered with spreading glandular hairs. Scape longer than the leaves. Flowers nearly ⅓in. long. . . . . Sepals linear-oblong, blunt. . . . Petals one-third longer than the calyx. Stamens 5, persistent. Ovary oblong, with 3 short styles, and globose papillose stigmata."

V. Moreover, in his describing *D. stenopetala* (another New Zealand species), he says, "This plant and the *D. uniflora* of Fuegia and the Chilian Andes form a peculiar group of this genus, differing from most others in the one-flowered scape, and from all in the styles being divided to the base" ("Flora N.Z.," vol. i., p. 19)—which is also the case in this species.

2. *D. triflora*, sp. nov.

A small stemless species. Roots 2–3, very long, vertical, rather stout, wiry, black, finely shaggy below. Leaves rosulate, spreading, 15–18, orbicular, 2 lines diameter, red (as also glands), lamina thickish, the under-surface glabrous, roughish; glands very large, spreading, flattish, covering lamina on upper surface and partly on petiole; petiole 3 lines long, flat, broad, glabrous, dark-greenish; stipules large,

sub-scarious, brownish, tips bifid and much and sharply laciniate, cells oblong, minute; with additional transverse stipules or scales on petiole at base below and in front of lateral stipules, sub-quadrate, 1 line broad, the top deeply laciniate with 7–8 long acuminate laciniæ. Scapes rather stout (for plant), the main (or central) one $\frac{3}{4}$in. long, erect, bearing at top 3 flowers (rarely 2) in a sub-fascicled corymb; pedicels $\frac{1}{15}$in. long, with 2 minute bracteoles together at their fascicled base; other scapes axillary, simple, their stems $\frac{1}{2}$in. long, 1-flowered, with a single small bracteole below calyx. Calyx broadly campanulate, $\frac{1}{10}$in. long, dark-red, 5-lobed; lobes cut nearly halfway to base, rounded and sub-acute; tips thin, many and sharply toothed; teeth irregular; veined, veins many, prominent, branching. Corolla (damaged) whitish, small, extending but little beyond calyx.

Hab. Swampy spots, base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Order XXVII. Halorageæ.

Genus 1. **Haloragis**, Forst.

1. *H. bibracteolata*, sp. nov.

A small spreading ascending few-branched wiry herb; branches 5in.–7in. long, wiry, few-leaved. Leaves opposite in pairs, distant (1in. or more apart), petioled, broadly oblong, sub-acute, 2–3 lines long, reticulate, margins thickened, white, recurved, usually with 3 coarse and deep curved laciniate serratures on each side, which also have thickened margins, upper surface glabrous, the lower hairy, also petioles and stems; petioles short. Flowers axillary, solitary, peduncled, opposite (generally 2 pairs) at tip of branch, 3–4 lines apart. Nut small, with flower 1 line long, smooth, glossy, purple, obtusely 4-angled, turgid; 2 appressed bracts at base, glabrous, ovate-lanceolate; peduncle very short, slender. Calyx-lobes erect, deltoid-acuminate, margins thickened and recurved, with a thick central line resembling a midrib. Stigmas 4, sessile, large, spreading, echinately bushy; hairs coarse, septate-moniliform, obtuse. Anthers linear, truncate, emarginate, yellowish, pendulous. Petals 0.

Hab. Dry spots, sides of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. I. A species having pretty close affinity with *H. depressa*, Hook. f., but differing from that species in its leaves being glabrous, smaller, and petiolate, with different serratures, and not "slightly scabrid on each side;" also, in its nut being much smaller, less angled and costate, with 2 bracts, and in its very different stigmas.

II. Bentham, in his more full and more recent description

of *H. depressa* (it being also an Australian plant), says, "Leaves small, entire or slightly toothed, ... scabrous with minute asperities; . . . . fruit with 4 or 8 prominent nerves." And, again, "There are two forms of this species: 1. *serpyllifolia.* Leaves mostly under 3 lines long and rather narrow. *Goniocarpus serpyllifolius* and *G. vernicosus*, Hook. f., in Hook. 'Ic. Plantarum,' tt. 290 and 311. And, 2. *montana.* Leaves broader, often cordate, 3 to 5 lines long." I have the drawings, with dissections, of both those species (or forms), which differ largely from this plant here described; besides, I know *H. depressa.*

Order XXVIII. MYRTACEÆ.

Genus 2. **Metrosideros**, Br.

1. *M. speciosa*, sp. nov.

"A small tree, bushy at top, about 25ft.–30ft. high; probably a climber" [Mr. Hamilton]; wholly glabrous. Branchlets sub-4-angled, bark dark reddish-brown. Leaves oblong and oblong-lanceolate, obtuse, 1in.–1¾in. long (attaining to 2½in. on young luxuriant barren lateral shoots), decussate, distant ½in.–¾in., spreading, petiolate, dark-green alike on both sides, plentifully dotted with large and small dots, glossy on upper surface, midrib stout, much veined, lateral nerves oblique, irregular; petioles 1–2 lines long. Flowers stout, large, in small terminal and sub-terminal corymbs (sub 11-flowered); peduncles (and pedicels) rugulose and dark-coloured, slender, ¾in.–1in. long, with 3–4 minute transverse ridgy equidistant bracteoles, and also 1 at base of pedicel; secondary peduncles 3 lines long; pedicels very short; flowers disposed in heads of 3, and when terminal of 5. Calyx infundibuliform, smooth, thick, 8 lines long; lobes large, broad, rounded, concave, persistent; margins membranaceous and dotted. Petals 5, large, sub-orbicular, showy, 3 lines diameter, orange with a reddish (or pink) tinge, veined, thickly dotted with large dots; margins entire at tips, slightly erose at sides; claw broad, short. Stamens (and style) dark-red, 8 (rarely 9) lines long, flat, thin; anthers oblong, red; pollen (plentiful) bright-yellow (gamboge); style stout, erect, 1in. long, much longer than stamens. Fruit not seen.

Hab. Forest-clearing, 1 mile north of the Waikanae Railway-station (Manawatu line); April, 1889: *Mr. A. Hamilton.*

Obs. This species is pretty closely allied to *M. florida*, Sm., but differing in several particulars—viz., in general colours of bark, leaves, and inflorescence, which are all much darker; in its angled branchlets, in the position form and venation of its leaves, in its smaller heads of flowers with their larger and more vividly-coloured petals stamens and styles, in its longer

styles far exceeding the stamens, and in its larger and more richly-coloured anthers. In its flowering state it is a strikingly handsome plant.

Order XXXVIII. Rubiaceæ.

Genus 1. **Coprosma**, Forst.

1. *C. aurantiaca*, sp. nov.

An erect rather rigid thickly-branched glabrous shrub, 8ft.–10ft. high; bark brownish. Branches opposite, spreading, sub-rigid, patent; branchlets minutely and thickly puberulent. Leaves lateral in opposite pairs, and 2–4 together fascicled at tips of small branchlets, oblong and oblong-obovate, 5–7 lines long, 2½–3½ lines broad, glabrous, green, somewhat thickish, margins sub-sinuate red; tips rounded, sometimes slightly apiculate, minutely ciliolate; much reticulately veined, veins not prominent; tapering to base of petiole; petiole very short, glabrous. Stipules very small, sub-ovate, thickish, puberulent. Flowers: *Male*, sub-sessile, axillary, solitary in opposite axils, and sometimes 3 together. Calycine lobes 4, connate; 2 of them large oblong obtuse, opposite, margins entire; and 2 small, their tips irregularly toothed, coloured, their edges minutely ciliolate. Corolla broadly campanulate, greenish dashed with purple streaks, 2 lines long, 3 lines diameter, 5-cleft cut three-fifths to base; lobes sub-oblong-ovate, sub-acute, spreading, much recurved, 1-nerved with branching veinlets at tips. Stamens 4, much exserted, pendulous; filaments puberulous; anthers one-third length of filaments, oblong, striate; tip obtuse; base sagittate. Fruit solitary, globular, size of a small pea, stalked, clear golden-yellow, very sweet. Seeds narrow-oblong, 2 lines long, white, thickish, gibbous and deeply striate on the outside, flattish and smooth on the inside.

Hab. On low flats, sides of streams, open lands south of Dannevirke, County of Waipawa; 1886–89: *W. C.* Forming dense impenetrable thickets; also, but more sparingly, in similar localities near Norsewood; 1884: *W. C.*

Obs. This plant has been known to me for some time, especially in its fruiting state, when it is a conspicuous object even at a distance, from the profusion of its bright-golden fruit. Its flowering-season must be both early in the spring and soon over, for I had visited the shrubs late in August, when there were no signs of flowers; and again afterwards early in October, when there was not one remaining of the female, and only a very few of the male flowers. At the same time the many other species of *Coprosma* close by had scarcely yet expanded their flowers. Through my not having met with perfect flowering specimens, I had delayed describing

the plant. Its leaves lose their colour in drying, becoming yellowish.

2. *C. lentissima*, sp. nov.

A small sub-erect slender weak glabrous shrub, 4ft.–5ft. high; bark pale-brown, on its younger branches slightly yet closely puberulent; branches few, distant, very long and straggling, often simple, the younger ones sub-tetragonal; branchlets mostly simple, very slender and very long, 12in.–18in. and upwards, often supported by other neighbouring shrubs and plants. Leaves not numerous, in distant opposite pairs, almost regularly disposed sub 1in. apart on their long branches, oblong and sub-oblong-obovate, 5–7 lines long, 3–4 lines broad, membranous; margins entire, thickened, and slightly recurved; tips rounded; veins much reticulated but nearly obsolete; dull-green above, paler below and shining; petiole short, 1 line long, slender, glabrous. Stipules small, broad, somewhat sub-quadrangular, minutely ciliolate. Flowers: *Male*, axillary and at tips of very short lateral branchlets (1–3 lines long), usually 4-fascicled (sometimes 3 or only 2), shortly-peduncled, glabrous. Calyx small, green. Corolla (unexpanded) oblong, 2 lines long, green, striate; tips slightly ciliolate. Anthers (immature) long, narrow linear, dark-purple. *Female* flowers and fruit unknown.

Hab. Outer edges of woods, open plains south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. This is a very peculiar species, from its long slender simple and very pliant branches. Its leaves and *male* flowers resemble (*primâ facie*) those of the preceding species (*C. aurantiaca*), but the size, form, habit, colour, and general appearance of the two plants are totally distinct. The leaves of this species, too, are much more regularly disposed, less obovate, thinner in texture, with their margins not coloured and tips not ciliolate, and of a paler green, keeping their colour in drying; the petiole longer and more slender; its calycine lobes are also much smaller. Although I have known it for some time, and often visited its locality, where it is common (yet at the wrong seasons), I have not met with female flowers or fruit.

3. *C. orbiculata*, sp. nov.

Shrub small, erect, 5ft.–7ft. high, slender, graceful, much branched above, bark smooth, light-brown; branches short, opposite, patent; branchlets small, very slender, pubescent; hairs short, light-grey. Leaves numerous, orbicular, 3–4 lines diameter, often a little broader than long, sometimes minutely apiculate; margins slightly recurved; lamina rather abruptly contracted at petiole, membranous, light-green on

both sides, glabrous, sub-trinerved, veins much reticulate; petiole slender, $\frac{1}{10}$in. long, pilose. Stipules small, connate, toothed. Flowers: *Male*, mostly on small branchlets, axillary and lateral, opposite, 2 together (sometimes solitary), shortly-peduncled. Calyx small, 4-lobed (2 of them larger); lobes triangular-ovate; tips slightly ciliolate. Corolla small, campanulate, $\frac{1}{10}$in. long, green purple-dashed the base purple, glabrous, 4-cleft, cut half-way down; lobes obtuse, 1-nerved, spreading, recurved, papillose-ciliate at tips. Stamens 4, exserted, 3 lines long; filaments 2 lines long, slender, thickened at top, papillose; anthers white, narrow-oblong, 1 line long, tip obtuse, base sagittate. *Female* flowers and fruit unknown.

Hab. Shaded forests south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. This is a very neat-looking species, of a pleasing green colour (which it also in great measure retains in drying): the regularity of its many small and round leaves, on its patent almost horizontal spreading branches, serves greatly to enhance its graceful appearance. It is one of the common undershrubs of those deep forests, and the sole reason of my not detecting any *female* flowers was my being there too early in the season. It is very distinct from all other species of *Coprosma* known to me.

4. *C. perpusilla*, sp. nov.

Shrub small, depressed; main stem prostrate and creeping (under soil?), 4in.–6in. long, rooting at nodes from lower surface; bark pale, glabrous. Branches secund, erect, about 1in. high, opposite in pairs, simple, few-leaved; young stems glabrous, sub-succulent. Leaves very close, imbricated, thickish, elliptic, 2 lines long, obtuse, glabrous, dark-coloured; upper surfaces minutely and closely papillose; margins entire, thickened and slightly recurved; veined (seen between eye and light); veins branched, anastomosing near margins; tapering to petiole; petiole short, broad, 1-nerved; leaves smaller and narrower (1 line long) at tips and around flower. Stipules narrow, somewhat crescent-shaped, finely ciliolate. Flowers: *Male*, solitary, terminal; calyx small, thick, 4-lobed, cut to base; lobes deltoid-ovate, obtuse. Corolla thickish, broadly tubular, 2½ lines long, 4–5-lobed; lobes sub-acute, one-third length of tube, 1-nerved; margins and tips papillose and sub-fimbriate. Stamens 3, 4 (sometimes 6), exserted; filaments very long, 4–5 lines, pendulous; anthers linear-oblong, 1½ lines long, apiculate, sagittate. *Female* flowers not seen.

Hab. On low banks of River Wangaehu, near east base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A species having pretty close affinity with *C. repens*, Hook. f., and *C. pumila*, Hook. f. (inhabiting also the same

mountain region), but, I think, clearly distinct from both. I received but a few small specimens of this plant, and half of them were destitute of flowers.

Order XXXIX. COMPOSITÆ.

Genus 1. **Olearia**, Mœnch.

1. *O. ramuliflora*, sp. nov.

A tall erect much-branched shrub, 8ft.–10ft. high; branchlets opposite, very long, slender, erect and drooping, often simple, angled, striate, bark reddish-brown. Leaves few, small, opposite, fascicled usually in fours, distant, sub ¾in.–1in. apart on branchlets, or springing from knobbed nodes with 2–3 small obtuse brown hairy bracts at base, linear-spathulate, 3–4 lines long, 1 line broad, obtuse, rather thickish; margins entire, recurved; tapering into petiole 1 line long; dark-green and glabrous above (but young ones with a few scattered weak sub-strigillose hairs), whitish below with fine closely-appressed hairs which are reddish on petioles, and also on midrib when young; hairs narrow lanceolate, peltate. Heads numerous, 2–4-fascicled together with the leaves (sometimes but rarely solitary), broadly campanulate, 3 lines long, on long slender peduncles 3 lines long, curved, pubescent, bibracteate; bracts opposite, ovate, acuminate, spreading, pubescent. Involucral scales 12, in 2 (sub 3) rows, spreading, strigosely hairy, sometimes glabrous; the outer generally 5, short, linear-ovate; the inner 7–8, linear, obtuse, 2 lines long, tips woolly and, with margins, much ciliate. Florets generally 12; of the disc 4, the ray 8, whitish, their tubes and 2 lobes of the disc-corolla slightly hairy; hairs long, straight; tube of ray-florets very short, its limb largely trifid; lobes linear, 1-nerved; stigma very long, glabrous, dark-coloured; style of disc-floret flattish, veined; stigma (sometimes trifid) long, spreading, each lobe 1-nerved; tips acute, dark-coloured, roughly tuberculate; tubercles linear. Pappus few, erect, shorter than floret, white, shining, slightly scabrid, not thickened at top; tips acute. Receptacle small, pitted, ridgy. Achene small, linear, $\frac{1}{20}$in. long, dark-coloured, glabrous, with a few short pale spreading hairs at top.

Hab. Sides of streamlets, open ground, south of Dannevirke, County of Waipawa; 1887–88: *W. C.* (Flowering in December.)

Obs. This species is pretty nearly allied to *O. virgata*, Hook. f.; differing, however, in several important characters—as, in its larger size, its very long pendulous and simple branchlets, its smaller leaves, more numerous fascicled heads, its more and longer involucral scales, bibracteate peduncles, and its greater number of ray-florets, with longer limb.

According to Bentham's arrangement, from the composition of its indumentum this plant will belong to his Section I., *Dicerotriche*. It is a very handsome shrub when in flower.

2. *O. erythropappa*, sp. nov.

"Shrub 7ft.–9ft. high." Branchlets rather long, open, striate; bark pale reddish-brown, hairy; hairs closely appressed. Leaves alternate, distant, sub-orbicular, 3½in. and 3in. long by 2½in. wide, flat, membranaceous, glabrous above (having a few short, scattered adpressed white hairs when young), with closely-appressed light-greyish narrow fusiform peltate hairs below, of a pale-reddish hue when young, finely reticulate; midrib and principal veins below very hairy, dark red-brown; margins sinuate or sinuate-toothed, their sinuses few, large, shallow; base sub-truncate; tip slightly produced, sometimes sub-apiculate; petiole slender, 1in.–1½in. long, striate, hairy. Leaves much smaller and narrower on flowering branches near the flowers, 1in.–1½in. long, oblong and more closely sinuate-toothed or sub-crenate. Heads reddish, in small graceful slender open corymbs, axillary and sub-terminal, 3in. long, with a long linear brown hairy bract at base of each branch of corymb; peduncle striate, densely covered with red-brown appressed hairs with a few scattered whitish ones; secondary peduncles sub 1in. long with 3–4 heads on long slender pedicels; pedicels sub ½in. long, hairy, with a small bracteole about the middle. Head small, spreading, about 4 lines diameter. Involucral scales sub 20 in three rows, the outer shortest, sub-linear-ovate, very hairy; hairs fawn-colour; the middle ones with a central hairy line; the inner longest, 2 lines long (twice the length of the others), glabrous, very thin, red-brown, much ciliate. Florets few, sub 20 in all: of the ray, limb narrow recurved, tip with 3 blunt notches, tube rather long, slender, base spreading, hairy; hairs obtuse, somewhat septate or transparent with a dark twisted centre; style long, exserted; stigmas long, spreading, glabrous, curved, tips slightly scabrid: of the disc, corolla glabrous, 6-cleft, tips obtuse, muricated, stem slender, hairy; stigmas scabrid. Receptacle small, pitted, edges slightly scaly. Pappus short, shorter than disc-florets, irregular in length, scabrid, tips acute; the upper portion bright-red, showy. Achene narrow, linear, terete, very hairy.

Hab. Thickets, base of Mount Ruapehu, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. This species differs considerably from all the many indigenous species described by Sir J. D. Hooker: its nearest affinities seem to be with *O. populifolia*, Col. ("Trans. N.Z. Inst.," vol. xiii., p. 243), and *O. suborbiculata*, Col. ("Trans.

N.Z. Inst.," vol. xviii., p. 263)—both of these species also obtained from the same interior mountain locality. From its indumentum it will fall under the same section as the preceding.

3. *O. uniflora*, sp. nov.

A tall shrub or small tree, "12ft.–16ft. high; branches very compact." Branchlets numerous, short, striate, light reddish-brown, pubescent; as also petioles and panicles. Leaves sub-coriaceous, dryish, broadly ovate obtuse, and sub-oblong-orbicular, 1in.–2in. long (but rarely attaining to 2in.), ¾in.–1¼in. broad, base sub-truncate, green, glabrous and shining above, with closely-appressed starry pubescence below of a light fawn-colour, with a reddish hue in the young leaves; coarsely waved; margins entire, whitish, and slightly thickened; very closely and regularly reticulate, reticulations small, sub-quadrate; the rays of the starry indumentum flat, flexuous, and acute; petioles slender, 4–7 lines long, sub-terete, channelled. Panicles axillary and sub-terminal, longer than leaves, compound, loose, erect, slender, somewhat regular in shape, neat; peduncles and sub-peduncles about 1in. long, each with an adpressed ovate-acuminate bract at its base. Heads small, narrow, rounded, 2½ lines long, usually 2 together and sub-sessile on short secondary sub-peduncles, sometimes only 1 and then pedicelled, always composed of a single tubular floret. Involucral scales green, in sub 3 rows, slightly scurfy and puberulent; the outermost sub-rhombic-ovate, acute; the inner larger, thinner, paler, oblong, tips rounded of a dark lilac-colour with their margins delicately fimbriate; lobes of corolla 5 (sometimes 3), white, narrow, acuminate, entire, much recurved forming a complete revoluted curl, tube smooth; anthers narrow linear acute, orange with a brown line; style long; stigma large, much produced beyond anthers, curved, spreading, yellow, tips sub-spathulate finely tuberculate, their apices coloured pink. Pappus whitish with a reddish hue, irregular, shorter than floret, scabrid, thickened and flattened near the top, tips acute. Receptacle small, glabrous, dark-brown, alveolate. Achenium 1½ lines long, sub-linear-cuneate, terete very slightly compressed, striate, brownish, pubescent in the upper half.

Hab. Hills at Ohariu, West Coast, Cook Strait, near Wellington; and cultivated at Wanstead, near Waipukurau, County of Waipawa: *Mrs. E. Crosse.* Flowering in March, and very sweet-scented.

Obs. According to Bentham's classification, this species will belong to his § II., *Asterotriche.*

Genus 3. **Celmisia**, Cass.

1. *C. membranacea*, sp. nov.

Plant small, erect, 4in.–5in. high. Rootstock vertical, thickish, also horizontal long and slender, sending out long narrow leafy stolons. Leaves sub-rosulate, 8–10, close, spreading, orbicular-elliptic and broadly oblong, ¾in.–1in. long, membranous, green on both sides, glabrous, minutely glandular on upper surface and margins with depressed circular glands or dots, but not puberulent, finely reticulated, margins slightly revolute and sharply serrate, teeth rather long, curved; petiole flattish, 3–4 lines long. Scape solitary, erect, slender, 3in.–4½in. high, thickly glandular pubescent (also involucre), with 5–8 cauline bracts, narrow linear, acute, 3 lines long, equidistant. Head hemispherical, ¾in. diameter. Involucral scales numerous in 4 rows, linear, the inner row longest, 3 lines long, dark-green, 1-nerved, glossy within the apical portion, and tips largely ciliate. Florets very numerous: of ray, 20 or more, limb long narrow, revolute, 4-veined, tip slightly 3-notched, tube very short and slender, glabrous; stigma long, exserted: of disk, 32, corolla infundibuliform smooth, 5–6-lobed; lobes sub-acute; stigmas slightly exserted. Receptacle deeply punctiform, with irregular and high scaly margins. Pappus shorter than tube of disc-florets, of irregular lengths, scabrid, acute, reddish. Achene linear somewhat quadrangular, striate, sub-compressed, pubescent on striæ, base finely beaked.

Hab. Open lands at Taupo; 1889: *Mr. H. Hill.*

Obs. This species is very near *C. glandulosa*, Hook. f. (a plant collected by me in that same locality), but differs from *C. glandulosa* in having membranous and broader leaves without pubescence, and with differently-formed glands, long petioles, numerous scales to involucre, and a much larger number of florets; its achene also being angled, &c.

2. *C. perpusilla*, sp. nov.

A very small plant, sub-erect and slightly tufted; rootstock stoutish, straight, 1½in. long, with many long wiry rootlets at the extremity. Leaves 8–14, linear-lanceolate, sub 1in. long, 1½ lines wide, margins entire, tip obtuse, pale-green, glabrous above, very cottony closely appressed and shining below, concave, conduplicate. Scape short as long as leaves, single, erect, leafy, with a few small bracts, very woolly. Head small, 4 lines diameter, spreading. Outer involucral scales 5, broadly oblong, woolly in the centre; the inner 7 linear, glabrous, longer than outer, green and shining below, their tips obtuse, notched, with 1 circular brown spot,

margins white, hyaline; florets about 14, very slender almost setaceous, a little shorter than pappus. Receptacle narrow, ridgy. Pappus few, about 20, scabrid throughout, tips acute. Achene linear-lanceolate, dark-brown, scabrid.

Hab. Swampy spots near Rangipo, eastern base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A small and curious species, of which more erfect specimens are much desired. I have received several plants together in a little lot as collected, but only two of them bear heads of florets, one of these being also immature.

Genus 5. **Lagenophora**, Cass.

1. *L. strangulata*, sp. nov.

Plant small, slender, graceful, erect, slightly tufted; rootstock vertical, long. Leaves 9–13, dark-green, sub- (sometimes oblate-) orbicular, 3–5 lines diameter, base somewhat sub-truncate and abruptly tapering, margins crenate-serrate, usually only 2 serratures on each side, rarely 3 and when so confined to the one side, serratures and tip apiculate, membranous, minutely reticulate, strigosely hairy on both surfaces; hairs long, flaccid, jointed and strangulated, patent, white, shining; margins ciliate, also petioles; petioles very slender, ½in.–1in. long. Scape slender, very long 3in.–4½in., with 1–2 minute distant linear acuminate bracts, glabrous below, pubescent above near head, where it is also thickened. Head small 2½ lines diameter, sub-hemispherical; involucral scales 16, disposed somewhat in 3 rows, the outer shortest, linear-lanceolate, glabrous, greenish, the margins above scabrid, tips lacerate and acute. Ray-florets 14–16, limb linear, very membranous, much recurved, white; tube very short, hairy; hairs patent, short: disc-florets few, about 6, tube slender, sub-cylindrical, 5-cleft, tubercular, tips obtuse; stigmas exserted, tubercular. Achene fusiform, turgid, minutely and thickly tuberculate throughout.

Hab. Among other low herbage, open grounds dry edges of cliffs banks of a stream south of Dannevirke, County of Waipawa; 1888: *W. C.* Swamp at Rangipo, eastern base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A species having close affinity with *L. petiolata*, Hook. f., and also, though not so close, with *L. forsteri*, D.C., and *L. commersonii*, Cass., but differing from them all in its thinner orbicular and reticulate leaves, with their striking silvery septate hairs and fewer serratures, in its numerous involucral scales with lacerate tips, and in its tubercular florets and achenes.

Genus 11. **Cassinia**, Br.

1. *C. spathulata*, sp. nov.

An erect spreading shrub 7ft.–9ft. high, of irregular diffuse growth, often 3-branched from base; bark of trunk and branches roughish, grey, with longitudinal fissures and cracks. Branchlets (and leaves below) covered with closely-adpressed pale-yellow tomentum, slightly glutinous when fresh; the branchlets numerous, long, sub-erect and patent, very slender, leafy, scarred. Leaves many, rather close but not crowded, regular, sub-decussate, spreading, linear-spathulate, 1–2 lines long, ½ line wide at top, tapering, thickish, green glabrous and shining above; margins thickened, slightly recurved; petiole very slender, decurrent. Heads numerous in terminal sub-hemispherical corymbs, 10–30 (usually about 20 together), narrow, tubular, 2 lines long, light-brown. Involucral scales several, closely appressed, slightly woolly, their margins finely ciliate, when young pale yellowish-green. Peduncles (and pedicels) pubescent, 1–4 lines long, with several small acuminate and opposite bracts, bearing 2–5 pedicellate heads; pedicels slender, 1–3 lines long, each with a small acute bract at base. Florets usually 9–10. Scales between florets linear with sharply-serrated and jagged margins, their tips produced dilated and rounded, pure-white, showy, sub-recurved, slightly laciniate. Pappus white, spreading, as long as florets, serrate with broad thickened tips. Achene linear, glabrous.

Hab. Dry hills near the sea, Napier, Hawke's Bay; 1860–89: *W. C.*

Obs. I have long known this shrub, which grows naturally here in the borders of my paddock on the hill; but until this year I had always supposed it to be one of the described New Zealand species of *Cassinia*—probably *C. leptophylla*. This summer, however (in February), I was attracted to it by its charming and showy appearance, so many hundreds of heads of pure-white flowers, formed by their large recurved scales; and on examination I found it to be a very distinct species. Its spathulate leaves yellowish below and sub-glutinous, larger heads of flowers, their coloured and woolly involucres, and their prominent white-tipped and largely-recurved floral scales, with the tops of the pappus flattened and coarsely serrate, form good differential characters.

Genus 14. **Gnaphalium**, Linn.

1. (?) *G. minutula*, sp. nov.

A minute plant of distinct simple growth; rootstock thickish for plant, vertical; rootlets long, wiry. Leaves 6–10, basal, linear, spreading, ½in.–¾in. long, $\frac{1}{50}$in. wide, tips obtuse, dark-green, glabrous above and on midrib below, white and

cottony on under-surface, their lateral margins incurved, often twisted. Scape single, $\frac{3}{4}$in.–1in. long, slender, almost setaceous, finely cottony, with 1–2 narrow acuminate cauline bracts. Head $2\frac{1}{2}$ lines diameter. Involucral scales about 10, spreading, sub-ovate-lanceolate acuminate, the inner series narrower linear acuminate, thin, light-brown (old), scarious, glabrous. Receptacle sub-papillose. Pappus sub 20, rather long for plant, white, spreading, flexuous, 2-nerved, scabrid below, upper portion smooth, flattish, tip obtuse. Achene $\frac{1}{24}$in. long, terete, slightly tuberculate; tubercles linear, patent.

Hab. In boggy ground, near eastern base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. This is a remarkable little tiny plant, yet, though very minute, attracting attention at first sight from its pure-white hair-like leaves, when closely incurved, contrasting so strongly on the black soil. Its pappus, on examination, reveals the most curious structure (as described), which is also constant, and (to me) unique. Although I have received several whole plants (in a little mass), yet only one possessed a floral head, and that old and imperfect, containing only its involucral scales with *one* seed! It may prove to be a species of *Senecio*, or of some other allied genus; yet, for the sake of its peculiar pappus, also of its filiform hair-like leaves, I have ventured to describe it.

Order XLI. CAMPANULACEÆ.

(Including *Goodeniaceæ.*)

Genus 5. **Selliera**, Cavanilles.

1. *S. microphylla*, sp. nov.

Plant very small, creeping, twiggy; main stems hypogæous, a few inches long, much branched, spreading, implexed, slender, woody, wiry, very flexuous, rooting at nodes, reddish-brown; branchlets very short, sub $\frac{1}{2}$in. long, yellowish, their tips only appearing above soil, procumbent, matted. Leaves few, small, much scattered, sometimes 3–4 at nodes, spreading, broadly lanceolate or sub-obovate-lanceolate, about 1 line long (some much smaller), thickish, entire, glabrous; petioles long flexuous, twice the length of leaf. Peduncle terminal solitary, 1-flowered, 1 line long; bracteoles small. Calyx-lobes rather large for plant, long, sub-acute, appressed, thickish, glabrous, shining. Corolla 2 lines long, glabrous, dull-purple, lobes 5 (sometimes 6), rather large, sub-acute, spreading, with dark veins regularly reticulated. Stamens 5; anthers elliptic, pale-yellow. Style longer than stamens, very stout, dark-brown, with dilated orbicular cup-like indusium, the margin slightly and minutely ciliate. Capsule (old)

about 1 line long, turgid, black, containing 7 seeds (in one only 4); seeds orbicular (sometimes irregularly shaped), semi-compressed, slightly convex on one side; margined, pale, shining.

Hab. Swampy ground at Rangipo, eastern base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. I. An interesting little plant, received by me in a small turfy lump of earth, cut out of the ground; its leaves and few flowers closely appressed to the soil, and forming a dense leafy mat, making it a difficult matter to extricate a fair specimen. The small capsules were old (of last year?), broken off from the plants, and more or less injured, but still containing their seeds, which were perfect.

II. This species has evidently pretty close affinity with *S. exigua*, F. Mueller (Benth., "Flora Australiensis," vol. iv., p. 82), another small species from Western Australia; but differs from that plant in several characters.

Order XLII. Ericeæ.

Genus 1. **Gaultheria**, Linn.

1. *G. epiphyta*, sp. nov.

Plant a graceful open shrub 3ft. high; trunk 1¾in. circumference; 9 main branches, distant, leafy, each about 2ft. long, slender, and drooping, with 8–10 branchlets radiating at top; bark light-brown, rather smooth; branchlets very hairy; hairs long, appressed, springing from muricated dots. Leaves green, alternate, pretty regularly disposed, distant, spreading, sub-membranaceous or very slightly coriaceous, petiolate, narrow oblong, apiculate, 5–7 lines long, margin thickened, recurved, serrate with a long slender mucro within the blunt tooth at tip of a lateral vein; veins much and closely reticulate; young leaves very membranous, flaccid, brownish. Flowers small, rather distant, single, axillary at tops of branchlets; peduncle stout, curved, 1½ lines long, with a few scattered minute narrow patent scales, and 3–4 sub-orbicular or broadly ovate bracts at base, amplexicaul and imbricate (sometimes one single one close under calyx), their apical margins uneven slightly jagged-toothed; tips apicular. Calyx 5-lobed; lobes ovate, sub-acute, entire, cut nearly to base, 1-nerved, pale. Corolla white, sub-urceolate, scarcely 1 line long, lobes 1-nerved, very obtuse, incurved, margins sub-granular-crenulate. Stamens short, muricated; filaments 1-nerved, broadly dilated upwards one-third length from base, margin sub-angular, narrow acuminate above two-thirds length towards anther; anthers orange-red, sub-orbicular urceolate, turgid, 2-awned; awns short, stoutish, incurved, part of and rising immediately and gradually

from the anther. Style long, erect, stout, $\frac{1}{16}$in., simple; stigma muricate- (or ray-) pencilled. Capsule small, sub-orbicular depressed, enclosed by enlarged slightly fleshy dark-red calyx. Seeds of various irregular shapes, mostly 3–4-sided, shining, finely dotted, light-brown.

Hab. Wood, south of Dannevirke, County of Waipawa; 1887–89: *W. C.*

Obs. I. This plant is a highly peculiar one: 1. From its precise habitat—epiphytal on a tree-fern, a species of *Dicksonia*, 12ft. high, and full-fronded, its caudex closely covered with two small climbing-ferns—*Hymenophyllum flabellatum*, Lab., and *Trichomanes venosum*, Br.—in matted growth; and therein, at 4ft. from the ground, flourishes this *Gaultheria* at an angle of 45°. It is the only instance I have ever known of a *Gaultheria* so growing. A few other forest shrubs and trees, however, are not unfrequently met with in such situations. 2. From its remarkably free, airy, semi-regular, and graceful form, differing much in this respect from the other known New Zealand *Gaultherias*.

II. It is pretty closely allied to *G. antipoda*, Forst. (which grows in profusion on the cliffy heights near), but differs from that and other New Zealand species and varieties in several characters—as in its sub-membranous and mucronate leaves, which are also differently shaped, and otherwise and much more veined, and most particularly in its muricated stamens, which are also of a different form and colour, &c. For some considerable time I supposed it to be a plant of *G. antipoda* (or of one of its varieties) a little altered in growth and appearance from its strange and unique habitat; but on dissection and examination (on my obtaining perfect and complete specimens) I found it to possess very different characters. Several botanists have pretty fully described *G. antipoda*, Forst., particularly A. Richard, among other New Zealand plants (in his "Voyage de l'Astrolabe: Part Botanique"), who has also given a folio drawing of the plant with good clear dissections, which show the great difference in the form, &c., of its stamens and anthers compared with those of this species. In his copious and clear description of *G. antipoda* he also says (*inter alia*), "Corolla — ovata, laciniis brevibus, revolutis, acutis; stamina—filamentis albis planis, infra medium dilatatis ovalibus basi angustatis; antheræ ovoidæ—apice bilaciniata, laciniis bicruribus; semina sub-ovata" (*loc. cit.*, p. 212). Of course, I am well aware of the many varieties (α, β, γ, δ, ϵ) given by Sir J. D. Hooker in his "Flora Novæ-Zealandiæ," in the "Handbook" ditto, and in "Flora Tasmaniæ," under his description of *G. antipoda;* but this plant differs from them all. Hitherto, in spite of all my diligent search in those woods, extending over three years, I have only met with

this one plant (though *G. antipoda* (*vera*) is both fine and very plentiful in dry open spots in that locality, as I have already noted), so that, should other plants not be fallen in with hereafter, the question may again arise (with others as it did with me) whether this plant is not a sportive form of *G. antipoda*, and the origin of a *species nova*.

2. *G. subcorymbosa*, sp. nov.

Shrub 3ft.–4ft. high, much branched, diffuse; branches (specimens) dichotomous, each 4in.–6in. long, and bearing 2–3 heads of flowers; branchlets spreading, slender, free, each with a head of flowers; bark red, roughish, with a few coarse scattered appressed hairs. Leaves numerous, alternate, patent, petiolate, sub-coriaceous, glabrous, narrow-oblong-lanceolate, 9–11 lines long, closely serrate throughout, serratures and tip obtuse, green on both sides a little paler below; veinlets clear, pale, much reticulated, causing many small oblong and variously-shaped dots; petioles sub 1 line long, glabrous. Flowers terminal in spreading corymbose panicles 1in. diameter, containing 20–25 flowers; peduncle, pedicel, calyx, corolla, and bracteoles all white; pedicels (and peduncle) finely and sparingly puberulent, 2½ lines long, curved, tribracteolate at the base; bracteoles clasping, imbricate, their margins finely serrulate. Calyx-lobes large, acute, minutely serrulate-fimbriate. Corolla 2 lines long, sub-campanulate, inflated, mouth slightly contracted; lobes small, revolute, their tips obtuse and minutely denticulate. Filaments white, sub-lanceolate acuminate, 1-nerved, thickly and coarsely muricated, the tips of points obtuse; anthers dark orange-red, base gibbous slightly emarginate and minutely muricatulate; awns stout, spreading their sinus very broad, rising immediately from anther, with a small acute lobe on each side at base of awn. Style and stigma simple. Hypogynous scales broadly deltoid, concrete, their tips very obtuse, thickened, brown.

Hab. On eastern slopes of Ruahine Mountain-range, County of Waipawa: *Mr. H. Hill.*

Obs. A very graceful species, apparently distinct from all known ones; its anthers somewhat approach those of *G. oppositifolia*, Hook. f.

Genus 8. **Dracophyllum**, Lab.

1. *D. tenuicaulis*, sp. nov.

A small much-branched shrub. Branch (specimen received) 3in. long, 2 lines diameter at base, naked; bark blackish-grey; bearing 15 small erect slender branchlets, each 1in.–1½in. long, ½–¾ line wide, minutely and regularly scarred

with annular cicatrices from old leaves; red-brown, glossy. Leaves at tops of branchlets, 12–15 on each, close, erect, recurved, slightly spreading, subulate, ½in. long, ½ line wide, canaliculate two-thirds of length, glabrous, shining, reddish; margins minutely serrulate; tips thickened, sub-terete, roughish, obtuse; the base largely dilated 2 lines wide, amplexicaul, closely imbricate; decreasing gradually in size upwards, the uppermost being only 4 lines long, the limb very short ½–1½ lines, with larger bases much overlapping, and their margins ciliate. Floral bracts orbicular, largely concave, margins finely ciliolate, 4 lines long, of which 2 lines form a long subulate thick obtuse mucro. Flowers terminal in small spikes of 3–7 flowers, closely compacted. Calyx, sepals small 1½ lines long, narrow linear acuminate; tips acute, margins membranous and finely ciliate. Corolla sub-campanulate or broadly tubular, 3½ lines long, sides straight, 5-cleft, lobes very small one-fifth length of corolla, triangular acute, margins crisped. Filaments very short, adnate above the middle. Anthers small, brown, oblong-cordate, 2-lobed; tip emarginate. Style short, stout; stigma slightly capitate, roughish, minutely jagged. Hypogynous scales sub-quadrilateral, obsoletely striate, broadest at top, apical margin sinuate.

Hab. Arid stony ground, high up on Mount Ruapehu, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A species having affinity with *D. recurvum*, Hook. f., and also with *D. rubrum*, Col.,* but differing from them in several characters.

2. *D. featonianum*, sp. nov.

"A small bushy shrub, about 4ft. high." Leaves at tips of slender branchlets, 12–25, erect, loosely spreading, sub-rigid, 1½in. long (2¼in. at base of panicle), 2–2½ lines wide at base above vagina, suddenly and slightly contracted, linear acuminate gradually decreasing to tip, flattish, slightly concave above, glabrous, striate, membrano-coriaceous, dull-green; margins finely serrulate; tip thickened, sub-acute. Floral bracts, at the base of each branch (or branches when 2 together) of the panicle, orbicular, ¼in. long, largely concave; margins thin, minutely ciliolate (*sub lente*); tip mucronate, 2 lines long; within the bract, at the base of each pedicel, are very narrow curved subulate and setaceous bracteoles 1–2 lines long, their upper margins ciliolate; tips acute. Flowers terminal in a small narrow sub-compact panicle, 2in. long, ½in. wide, stems striate, glabrous, with a few thinly-scattered minute white hairs, almost microscopic; branches free, 3–4 lines long, largely bracteolate, alternate in pairs, each with

* "Trans. N.Z. Inst.," vol. xx., p. 200.

3–4 flowers, and a very small broad apiculate persistent bracteole at base. Flowers small, reddish, pedicelled, spreading; pedicels very slender, 1 line long. Calyx half the length of corolla, sepals free, spreading, ovate, acute, ciliolate. Corolla 2 lines long, cylindrical or narrow campanulate, 5-lobed; lobes deltoid-ovate, obtuse, wrinkled, largely recurved, 1-nerved; margins and tips incurved. Filaments short, adnate above the middle of the tube; anthers small sub-orbicular cordate. Style rather long, longer than calyx, thickened below; stigma simple, scarcely capitate. Hypogynous scales very small, sub-oblong-rectangular, narrowed upwards, truncate, tip retuse. Capsules small, 5-cleft.

Hab. Whangaparaoa (Cape Runaway), a little north of the East Cape: 1889: per *Mrs. E. H. Featon.*

Obs. I. The floral leaves or bracts of this species can only be seen in the incipient state of its inflorescence, before expansion, as they all fall off very early. The preceding species, *D. tenuicaulis,* has also floral bracts very like these of this species, only they are much smaller and not so early deciduous. Writing from memory of 45–50 years, I believe I have often noticed a similar feature in the common northern species *D. urvilleanum,* A. Rich., and *D. lessonianum,* A. Rich, before flowering. And the same character has been fully noticed and described as pertaining to a large Tasmanian and Australian species—*D. milligani,* Hook.—by both Hooker ("Icon. Plant.") and Bentham ("Flora Austral."). And it is not unlikely that it belongs to other of our New Zealand species, though hitherto not described through their floral bracts falling off so very early.

II. I have named this species in honour of Mrs. E. H. Featon, of Gisborne, New Zealand—who has wrought so long and so diligently at our New Zealand botany—the accomplished authoress of "The Art Album of New Zealand Flora" (now in course of publication), who very kindly sent me the specimen I have described. In her letter which accompanied it she says, "The flowers are white and the buds pink, the leaves are a pale-green on top and glaucous below, having a purplish tinge as it approaches a buff-coloured sheath."

Order XLIII. Myrsineæ.

Genus 1. **Myrsine,** Linn.

1. *M. brachyclada,* sp. nov.

A small somewhat rigid much-branched shrub; branches short, bark darkish red-brown, smooth; branchlets numerous, very short, scarred. Leaves sub-fascicled at tips of branchlets and at nodes, 4–5 together, spreading, obovate and oblong, 3–5 lines long, sub-membranaceous, glabrous, the upper por-

tion crenate, tips very obtuse crenulate with 2–3 notches, the lower margins towards petiole entire and slightly recurved, darkish-green and dull above, pale and reticulated below, the cuticle rather loose and wrinkled; petioles slender, slightly hairy and ciliate, 1 line long. Flowers sub-terminal, 3–4 together, axillary among leaves at tips of branchlets, 2 lines diameter, dark-brown; peduncles 1 line long, slender, drooping; bracteas at base, small, brown, tips ciliate. Calyx-lobes 4, free, spreading, oblong, acute, 1-nerved, slightly pubescent, ciliolate at tips and margins. Corolla-lobes 5, cuneate, tips broad, irregularly notched or retuse, glabrous, sub 1 line long, twice the length of calyx, reticulately veined; veins dark, conspicuous, not reaching to margins. Anthers 4, large, ovate, pale, sub-cordate, tips acute. Stigma sessile, capitate, depressed, circular, irregularly 4-lobed, sunk in centre. Fruit not seen.

Hab. Sides of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. This species varies much from the other known indigenous ones, especially in the form of its leaves and of its corolla; also, in it being the only known one whose leaves are without pellucid dots and entire margins; its corolla also is much larger, the lobes differently shaped and copiously veined. I have received two good specimens, evidently gathered from different shrubs (and probably at different elevations): in the one the leaves are small, scarcely 3 lines long, and the branches clothed with filamentous lichens (*Usnea* with apothecia); while the leaves of the other specimen are from 4 to 5 lines long: in all other respects, however, these two specimens are alike.

2. *M. neo-zealandensis*, sp. nov.

Shrub erect semi-fastigiate, 6ft. high, slender, graceful, much branched; bark dark reddish-brown, smooth, striately wrinkled when dry; branches and branchlets long, sub-erect, slender, simple. Leaves few, distant, alternate, solitary, obovate, 1in.–1¼in. long, 5–6 lines broad, flat, membranous, glabrous, darkish-green above, pale below, margins entire with numerous intra-marginal pellucid red dots very close together; tip broadly rounded, sometimes (but rarely) slightly retuse; tapering to petiole; petiole slender, 1 line long; midrib prominent below; much veined, veins largely reticulate (*sub lente*). It also has a few solitary and scattered intervening very small leaves of 2–3 lines in length. Stipules linear, thickish, red; tips acute; slightly ciliolate at base.

Hab. Edge of a wood on open plain south of Dannevirke, County of Waipawa; 1889: *W. C.*

Obs. This is a pretty species, with a very striking appear-

ance, differing largely from all the other described New Zealand ones of this genus; as also from all others known to me; and, indeed, from all New Zealand shrubs and trees in general. Unfortunately, its flowers and fruit are still unknown; notwithstanding, I have no doubt of it being a species of *Myrsine*. I have only yet met with a single plant, although I have sought often and diligently for others.

Order XLVII. Apocyneæ.

Genus 1. **Parsonsia**, Br.

1. *P. ochracea*, sp. nov.

A bushy climbing shrub composed of many thickly-interwoven branches, rising to the height of 6ft.–7ft.; branches very long, slender, 1 line diameter, bark red-brown; branchlets very slender, almost wiry, short. Leaves opposite, distant, linear, 3in.–4in. long, 1 line wide, tips obtuse and sub-acute, glabrous, dark-green (drying olive-green), striate below, the lamina spreading at almost right-angles; petiole 1 line long, sub-vertical, with a small thick node at base. Flowers axillary, in small few-flowered graceful panicles, half as long as leaves (sometimes in larger open airy leafy panicles), usually 3- or 5-flowered; peduncles very slender, $\frac{1}{2}$in. long, puberulent (as also pedicels and lobes of calyx); pedicels filiform, opposite, 4 lines long, bracteolate at base; bracteoles linear, narrow, 1 line long, spreading; tips thickly ciliate. Calyx dark-green, nearly as long as tube of corolla; lobes long, narrow, obcuneate, tumid at base, margins membranous, ciliate; hypogynous scales conical glabrous obtuse. Corolla sub-campanulate, 3 lines long, ochraceous; lobes twice the length of tube, sub-oblong-spathulate, tip sub-acute, dimidiate excised on one side near the tip, slightly revolute, veined; largely overlapping in the bud. Anthers half exserted, sagittate, narrow, acute, with long divergent tails as long as anthers. Stigma capitate, semi-elliptic (glans form), constricted near base, base truncate. Pod sub-terete, acuminate, 6in. long, $\frac{1}{10}$in. wide, slightly puberulent, tip obtuse.

Hab. Edges of dry woods, south of Dannevirke, County of Waipawa; 1888: *W. C.* (Flowering in December.)

Obs. I. This plant has caused me a deal of close study and examination; partly owing to the great variableness in our species of this genus, and partly to Sir J. D. Hooker having reduced his original four species in the "Flora N.Z." to two species in his later work, "Handbook of the N.Z. Flora," with the remark, "I am convinced there are but two species of this genus in New Zealand" (*loc. cit.*, p. 187). To this, however, I cannot subscribe.

II. I have already described another species, *P. macrocarpa* ("Trans. N.Z. Inst.," vol. xiv., p. 331), and this present plant I also believe to be a valid species, or, at least, a well-marked and distinct variety. It differs considerably from the two well-known species in the "Handbook," *P. albiflora* and *P. rosea;* not merely in the remarkable and constant form and size of its leaves, but also in its much larger flowers of a different shape and colour, as well as in other characters (*vide* descript.).

III. I was much struck with the peculiar appearance and graceful beauty of the plant when I first saw it; though then (in May) it was not in flower, only in fruit; and it was through my going purposely to those farther forests in the following summer that I was rewarded by finding it in flower. It is certainly an elegant garden plant. In general, in the two other and commoner species (named above) the leaves vary materially on the same plant, even on the same branch; but such is not the case with this one.

Order LVIII. PLANTAGINEÆ.

Genus 1. **Plantago,** Linn.

1. *P. picta,* sp. nov.

Plant perennial, sub-rosulate, flat, appressed to ground, sub 3in. diameter; rootstock very stout and densely hairy; hairs rather long, red-brown, shining. Leaves sub 30, spreading, narrow-oblong-spathulate, 1in.–1¼in. long, 4 lines broad at middle, sub-coriaceous, opaque, veined, veins obsolete, margins entire with 3 distant narrow patent teeth (or sub-lobes) at middle on each side, glabrous with a few scattered weak hairs on the upper surface and forming small tufts at bases of teeth, and sub-ciliate at margins; tip subacute; petiole very broad, 2 lines wide, flat, 7-nerved, densely hairy at extreme base; hairs long, reddish-brown. Scapes 8–10 to a plant, 1½in.–1¾in. long, extending beyond leaves, slightly hairy (more so at top); hairs flattish, adpressed, white, articulate. Spike broadly- or deltoid-elliptic, obtuse, 5 lines long, sub-truncate and 4 lines wide at base, slightly compressed, 8–9-flowered, the lowest pair free, subsessile. Bracts large, broadly ovate, dark brownish-black with broad white membranous and ciliate margins, much veined, veins branching, hairy within at base between bract and calyx. Calyx-sepals (4) much the same as bracts, only narrower. Corolla large for plant, very membranous, lobes spreading, white with a dark longitudinal centre, broadly ovate, margins entire and not involute; tip obtuse, mucronulate, and minutely toothed on each side. Anthers exserted, ochraceous, large, 1 line long, ovate-cordate, the centre deeply sulcate; their basal extremi-

ties rounded; tip produced, apiculate. Style much exserted, thickened upwards, coarsely hairy.

Hab. On a small islet lying near the shore between Gable-end Foreland and Tolaga Bay; 1889: *Mr. H. Hill.*

Obs. This plant differs considerably from our other known New Zealand species. Its nearest ally seems to be *P. brownii*, Rapin; but on closely comparing it with the drawings and ample dissections of that species as given by Sir J. D. Hooker in his "Flora Antarctica," vol. i., tab. 43, it is found to possess several grave differential characters—*e.g.*, in its leaves being thinner and much more veined, and bearing tufts of jointed hairs on their upper surfaces, and very hairy at their bases; in the larger number of flowers in its spikes; in its bract and calyx-lobes having wide membranous white borders, with ciliated margins; in the long hairs between the bract and calyx; in the lobes of the corolla being broader, flat, and obtuse; in its anthers being of a different shape—the tip more acuminate, and their basal extremities broadly rounded, not acutely pointed.

Order LXIII. Polygoneæ.

Genus 2. **Muhlenbeckia**, Meisn.

1. *M. muricatula*, sp. nov.

A small low prostrate wiry undershrub. Branches implexed, long, very slender, striate, roughish; bark dark-brown; branchlets few, almost filiform, alternate, striate, sub-angular, finely and thickly muricated. Leaves few, alternate, scattered, 4–5 lines distant, linear, 4–5 lines long, $\frac{1}{30}$in. broad (sometimes smaller), thickish, no veins visible, dull darkish-green, shining, tips sub-acute, margins entire; midrib stoutish below; petioles tapering insensibly, thickish, sulcated, minutely muricated, and so midrib below; stipules large, brown, scarious, truncate, veins conspicuous. Flowers hermaphrodite, axillary, 2 together, sub 8–10 pairs, alternate, distant 3–4 lines apart in a terminal leafy raceme, their leaves small and decreasing in size to tip, sometimes without leaves and only stipules, which are large and bladdery, the middle vein of the outer one stout, aristate. Perianth white, 1½ lines diameter, 5-lobed, lobes oblong, 1-nerved, tips obtuse; peduncle 1 line long, white as perianth; style 3-branched, stigmas thick, each 3-branched. Anthers broadly elliptic, nearly sub-orbicular. Nut black, half exserted, 1½ lines long, smooth, shining, broadly ovoid-lanceolate, triquetrous, angles obtuse; the perianth-lobes persistent, membranous.

Hab. Summit of Mount Ruapehu, and within the old crater, on dry stony spots, County of East Taupo; 1889: *Mr. H. Hill.*

Order LXVII. THYMELEÆ.

Genus 1. **Pimelea**, Banks and Solander.

1. *P. lanceolata*, sp. nov.

Shrub erect, "3ft. high," much branched at top; glabrous except inflorescence. Branches regularly tubercled with scars from former leaves; bark reddish-brown, shrivelled; branchlets opposite and sub-fasciculate, numerous, spreading, sub-angular; bark light yellow-green. Leaves lanceolate, usually 2in. long, 3½ lines wide at middle (sometimes smaller), opposite, distant 3–4 lines apart, spreading, flat, light-green, midrib prominent below, principal veins very long almost obsolete, margins slightly recurved, tips acuminate, thickish, acute, somewhat suddenly contracted at base, petiole 2 lines long, with a minute tuft of erect hairy bracteoles in the axils; the floral leaves similar but shorter and a little broader. Flowers in small terminal corymbose heads, 8–15, peduncled; peduncles short, very hairy with coarse grey hairs. Perianth 8 lines long, white, rather thin, strigosely hairy throughout; hairs white, very thick and coarse at base; tube infundibuliform, throat wide, very narrow below, constricted near base; limb spreading, lobes broadly elliptic very obtuse rounded, each 2 lines long, margins slightly irregular, much and reticulately veined, veins red. Anthers large, oblong, slightly apiculate, adnate, 1 line long; stamens and style much exserted. Nut narrow ovoid, enclosed in membranous base of perianth.

Hab. Base of Mount Ruapehu, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. Its nearest ally among the known species of *Pimelea* is *P. longifolia*, Banks; differing, however, from that species in several characters, especially from the more minute and exact specific description of it as given by Bentham, "Flora Australiensis," vol. vi., p. 6.

2. *P. similis*, sp. nov.

Shrub erect, 2ft.–3ft. high; branched at top; glabrous except inflorescence. Branches spreading; bark dark-red, wrinkled, smooth; branchlets numerous, slender, very pale straw-colour, sub-angular. Leaves broadly lanceolate, 1in.–1½in. long, 5–6 lines broad, tips suddenly acuminate, obtuse, opposite, sub-decussate; fewer larger and more distant on branches, numerous and smaller on branchlets, flat, dull olive-green, upper surface cuticle smooth shining wrinkled, veined; midrib below stout and prominent; margins thickened sub-cartilaginous, white, recurved; petioles stoutish, short, 1 line long, somewhat broad and flat, pale-yellowish like branchlets; involucral leaves similar but broader, ovate-lanceolate abruptly

acuminate. Flowers in small terminal heads, 6–9, half hidden among the leaves, peduncled; peduncles short, sub 1 line long, curved, densely hairy or sub-silky, whitish, shining. Perianth ½in. long, brownish-red with grey hairs, very hairy about limb, hairs extending far beyond tips of lobes, scattered below; limb sub-erect not spreading; lobes narrow oblong, sub-acute, 1½ lines long, margins incurved, veins simple not reticulated; tube cylindrical, very slender throughout; throat narrow. Anthers scarcely half-exserted, very small, elliptic, about ½ line long; style exserted as long as perianth; stigma small, capitate, papillose. Nut ovoid, larger than in the preceding species, enclosed in membranous base of perianth.

Hab. Edges of thickets, base of Mount Ruapehu, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A species very closely allied to the preceding (*P. lanceolata*), so that it might easily be taken for it at first sight, and yet differing from it in many particulars. The principal differences are to be found in its shorter yet broader dull-green leaves, with thickened white margins; its much smaller and slenderer perianths, which are of a different colour, with their lobes narrower, acute, incurved, and not largely veined; and its very small half-included and differently-shaped anthers.

3. *P. microphylla*, sp. nov.

Plant small, shrubby, sub-prostrate, and compact; branches 3in.–4in. long, bark greyish-black, regularly scarred (also branchlets) from cicatrices of fallen old leaves; branchlets numerous, short, with greyish hairs between leaves. Leaves only at tips of branchlets for about ½in., quadrifariously disposed, regular, closely imbricate and appressed, elliptic, $\frac{1}{10}$in. long (sometimes smaller), margined, obtuse, concave, sessile, thickish, veins not visible, glabrous, yellowish-green; the floral leaves scarcely larger, but with a few fine ciliolate white hairs at tips. Flowers few, sub-terminal, solitary and 2 near each other, small, 1½ lines long, slightly hairy on the outside, brownish-red (when dried); tube as long as lobes; lobes oblong, veined; tips very obtuse. Anthers exserted; style as long as lobes.

Hab. Sides of Mount Tongariro, County of East Taupo 1889: *Mr. H. Hill.*

Obs. A very peculiar and pretty little species, apparently allied (though not closely) to *P. gnidia* and to *P. buxifolia;* differing from them both in its very small and closely-imbricated quadrifarious leaves, its solitary red flowers, and the rounded tips of its perianth-lobes. I have received several small specimens, which are all alike as to leaves, &c., but containing very few flowers.

4. *P. bicolor*, sp. nov.

A small shrub, main branches 2in.–3in. long, slender, erect; branches leafy, hairy, bark dark-red; branchlets 1in.–2in. long, very slender. Leaves numerous, lanceolate, 2–2½ lines long, concave, thickish, pale-green, glabrous, margined with a broad dark-purple line, extending on both surfaces, which is also constant, sub-sessile, decurrent, sub-imbricate on main branches, distant 2 lines apart in opposite pairs on young branchlets; petioles yellowish-brown; floral leaves similar but slightly larger. Flowers very small, sub-terminal, axillary, single or forming an opposite pair. Perianth 2 lines long, with a thick tuft of greyish-white hairs at base, urceolate, membranous, veined, reddish (when dry), very hairy; hairs long, straight, coarse, white, extending beyond tips of lobes; lobes very small, shorter than tube, broadly elliptic, obtuse; style exserted; stigma large, capitate, fimbriate. Nut enclosed, oblong, turgid, 1 line long.

Hab. Open spots, Taupo, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A species allied to *P. urvilleana*, A. Rich., and to *P. prostrata*, Vahl; also to *P. rugulosa*, Col. ("Trans. N.Z. Inst.," vol. xxi., p. 102).

5. *P. dichotoma*, sp. nov.

Shrub 2ft.–4ft. high, much branched; branches long, erect, very slender, regularly ringed with scars from old leaves; bark light reddish-brown, glabrous; branchlets in pairs, leafy at top, the young branchlets very hairy; hairs long, white, strigose, appressed. Leaves decussate, distant, sessile, linear, ½in. long, 1 line wide, recurved falcate, green somewhat obscure; tips and bases red; base a thickened knob; glabrous above, strigosely hairy below (as also floral leaves); hairs white, springing from coloured sub-muricated dots, and extending beyond tips in small pencils; floral leaves (usually 4) much larger and thinner, ovate-lanceolate, ¾in. long, 3 lines wide, sub-sessile, light-green, veined. Flowers terminal (at first, afterward axillary between branchlets), in small heads usually 8–9, sessile; perianth very hairy on the outside, 3 lines long, tube narrow, reddish and swelling below; lobes 1 line long, sub-oblong-ovate, very obtuse, veined, slightly spreading, white, much ciliate; throat red; anthers included; stigma slightly exserted, globular, minutely and densely pencilled.

Hab. Banks of streamlets, borders of open plains, Tahoraiti, County of Waipawa; 1889: *W. C.*

Obs. An extremely neat-growing open shrub, of graceful appearance when in flower (in October). A peculiar character is that of its young branchlets, which spring in opposite pairs from within the floral leaves, and grow very rapidly; so that,

while its heads of flowers are terminal on their first expanding, they soon become axillary between two long branchlets, which, on the flowers withering and falling off, become equally forked with a broad obtuse basal angle.

6. *P. heterophylla*, sp. nov.

Shrub small, erect; branches (specimens) 3in.–4in. long, slender, 1 line diameter, much branched at top; bark dark-coloured, slightly pubescent; branchlets erect, 1in.–2in. long, very slender, scarcely $\frac{1}{3}$ line in diameter; young branchlets red, glabrous, with a few scattered short appressed hairs. Leaves glabrous, slightly concave, decussate, petiolate, of 2 sizes and forms—(1) 2 lines long, broadly lanceolate, distant 1 line apart, free and spreading on flowering branches; and (2) 1 line long, narrow lanceolate, very close, crowded and imbricated on the smaller (and barren) branchlets; all narrowly margined red; petioles red, glabrous. Floral leaves similar to No. 1. Flowers terminal and sub-terminal, 2–4 together, small, their tips only appearing among the leaves. Perianth red, veined, very hairy; hairs white; tube $1\frac{1}{2}$ lines long; lobes (sometimes only 3) $\frac{1}{2}$ line long, rounded. Anthers enclosed. Style much exserted; stigma large, capitate. Nut enclosed, obovate, large (for plant) $1\frac{1}{2}$ lines long, dark-green.

Hab. Dry open spots, high up on Mount Ruapehu, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. A species pretty closely allied to *P. bicolor*, Col. (*supra*), and difficult in words clearly to describe their differences (which, indeed, I have had some labour in doing); yet, when the specimens are compared and examined together, their variance is apparent at once. I would, however, that I had received more and better specimens of both plants, and also of all specimens of *Pimelea* brought from the mountainous interior.

7. *P. polycephala*, sp. nov.

Plant (apparently) a very small low densely-compacted shrub. Branches (specimens) small, stems thickish 1in.–2in. high, the lower portion naked; bark dark-coloured; with many very small branchlets at top, $\frac{1}{2}$in.–$\frac{3}{4}$in. long, closely and regularly tubercled in ridges from old fallen leaves; scars glabrous; stems hairy between them; hairs coarse, of unequal lengths, dirty-white. Leaves thickish, densely imbricated, small, sub-rhombic-orbicular, 1–$1\frac{1}{2}$ lines diameter, base truncate, sessile, glabrous, yellowish-green; the lower ones keeled; those near the tops more orbicular, a little larger, and obsoletely veined. Involucral leaves in 3 rows, 3 in a row alternating, larger, sub-orbicular, tapering slightly to

petiole, very membranous, reddish, much-veined, veins forked and coloured a deeper red, largely hairy on the whole of the under-surface; hairs white. Flowers not seen (? too early in the season); but the floral leaves are clustered in several small heads (the size of a large pea) at the tips of branchlets, each head on a short stout stem 2–3 lines long, comprising 5–8 smaller heads on short pedicels, and each of these smaller heads contains the larger and hairy involucral leaves, more or less crumpled up: the whole most closely packed.

Hab. Near the summit of Mount Ruapehu, in dry stony ground, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. Not having received any flowering specimens of this peculiar and very distinct species, I should not have cared to describe it were it not for its striking abnormal floral leaves, which, being so widely different from its own proper leaves in appearance, size, texture, venation, and colour, present the *primâ facie* aspect of a corolla; and this is still further increased through these leaves being so greatly wrinkled and congested, and also very hairy on their outside. Moreover, this peculiar character in the floral leaves is one that hitherto has scarcely been found to pertain to the New Zealand species of *Pimelea,* although it is a common feature to several of the numerous Australian species of this genus. Bentham, in his "Flora Australiensis," describes 67 species, besides several strongly-marked varieties—species with other botanists.

Genus 2. **Drapetes,** Lamarck.

1. *D. macrantha,* sp. nov.

Plant small, prostrate, scarcely semi-shrubby; branches 3in.–4in. long, slender, brown, scarred; branchlets sub-secund, erect, regular, 1in. high, 1 line wide, simple, green, leafy throughout. Leaves closely appressed imbricate, linear-linguiform, obtuse, 1 line long, sessile, glabrous, striate, gradually increasing in length upwards on branchlets, the uppermost leaves larger, more acute, their apical margins sparingly ciliate, tips bearded. Flowers terminal at tips of branchlets, 3–4 together, free above leaves, white, conspicuous. Perianth sub-narrow campanulate, 2 lines long, lamina nearly 2 lines wide, sessile, with a ring of hairs around base but separate; tube strongly 8-nerved, glabrous, shining; lobes sub-elliptic, two-fifths length of perianth, 1-nerved, puberulous at the centre on the outside, their tips very slightly ciliate, each with two small sub-rotund yellowish scales at base. Filaments exserted, long, half the length of lobes; anthers sub-orbicular, yellow.

Hab. On the eastern slopes of Ruahine Mountain-range, County of Waipawa: *Mr. H. Hill.*

Obs. A species very unlike in habit and general appearance those two described indigenous ones—*D. dieffenbachii* and *D. lyelli*, Hook. f.—also, those other three species (forming the genus) of Tasmania, Fuegia, and Borneo; being smaller, neater and simple-branched, with larger and more numerous flowers.

Class II. MONOCOTYLEDONS.

Order I. Orchideæ.

Genus 3. **Bolbophyllum,** Thouars.

1. *B. tuberculatum,* Col.

Bulb ovoid, dark-green, glossy, clothed with minute white shining leprous circular bullate scales. Peduncle sub 1in. long, slender, with 3 sheathing cauline bracts, equidistant, membranaceous, pale, striate, 3-flowered. Flowers small, usually 3 (sometimes by abortion only 2), rather distant, on short pedicels, each with a sheathing bracteole at its base. Perianth triangular, very oblique, gibbous at base (as in young *Dendrobium cunninghamii*), whitish, very membranous; sepals of nearly equal length, their tips and upper margins of a violet tinge, slightly open, when fully expanded 2½ lines broad; dorsal sepal narrow, ovate, 1-nerved; the lateral pair much broader, triangular-ovate, dimidiate, 3-nerved, sub-acute, connate in front under joint of labellum; petals white, ovate, obtuse, 1-nerved, ½ size (or less) of sepals; labellum exserted, sometimes the lamina is erect and falls back on the column, 1 line long, sub-ovate-oblong, tip sub-acute, thickish, smooth, margin entire, bright vermilion-red with a central yellow line running to base, base truncate with 2 small longitudinal ridges at posterior part, its margins thin incurved, claw slender very long (nearly as long as lamina), yellowish, the joint excessively mobile. Column minute, lateral appendages sub-triangular, hyaline, their tips retuse, with a minute glossy gland at base in front; anther pale-yellow, tip circular, slightly erose. Capsule oblong, turgid, 3 lines long, striate; striæ light-red. Leaves, &c., as already described, only some are larger 9–12 lines long and purple below; veins (in fresh state) not visible. Ovary and peduncle tuberculated as described. ("Trans. N.Z. Inst.," vol. xvi., p. 336.)

Hab. Epiphytal on trees, forming pretty large and closely-matted masses, woods near Palmerston, County of Manawatu; April, 1889: *Mr. A. Hamilton.*

Genus 12. **Pterostylis,** Br.

1. *Pt. speciosa,* sp. nov.

Plant stoutish, erect, 9in.–10in. high; stem and leaves of a reddish hue. Leaves: basal 0, but 2–4 small ovate pale

scales, distant on lower stem; cauline 4, nearly equidistant, much longer than flower, 5in.–8in. long, ¾in. broad at middle, linear-lanceolate, acute very thin, sessile, clasping, much and reticulately veined, light-green. Perianth large sub 2in.; segments rather loosely spreading, richly variegated with bright-red dark-green and fawn colours, the upper portions of segments brilliant red; largely veined; veins very prominent. Dorsal sepal large, acuminate, slightly tailed; lateral sepals connate, erect, largely spreading above and behind dorsal, tails long; sinus very broad, base emarginate; lateral petals loose from dorsal sepal, their tips very acute, not tailed; tongue linear-lanceolate, 2 lines wide, veined, reddish, minutely and thickly papillose; tip obtuse, thickish and slightly knobbed; appendage long, curved, fimbriate. Column long, wings broad, auricles long wide rounded, two subulate horns arising from outer angles shorter than the column, the margin between them slightly erose; stigma large, wider than column.

Hab. Near Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

2. *Pt. auriculata*, sp. nov.

Plant erect, glabrous, shining, 10in.–12in. high; stems bright-red. Leaves: basal 0; cauline 4, lanceolate very acuminate, 5in.–7in. long, ½in. wide, sheathing at base, pale-green, midrib reddish. Perianth 1½in. long, narrow, graceful, green with a reddish tint. Dorsal sepal and lateral petals narrow, sub-ovate, sharply acuminate, not tailed; lateral sepals erect, connate, sinus large, lobes narrow, long, spreading, tailed—tails nearly 1in. long; tongue dark-red, linear-oblong, sub 1in. long, 2 lines wide, middle nerve stout, flexuous, with 4 flexuous longitudinal veins on each side, the tip truncate and slightly bifid; appendage wide, shortly curved, coarsely fimbriate. Column long, slender, wings produced upwards in subulate tips nearly 1 line long, with very long and narrow auricles 2½ lines long, their tips closely and finely fringed. Ovary slender, somewhat linear, 1in. long, reddish.

Hab. Open fern land, Fortrose, Invercargill; 1889.

3. *Pt. polyphylla*, sp. nov.

Plant light-green, very slender, erect, 7in.–9in. high. Leaves very membranous, veined, reticulations large somewhat in squares; basal 6–7, forming a sub-rosette, oblong and oblong-ovate, 1in. long, petioled; petioles tapering, membranous, ½in. long; cauline 6–7, sub-erect, narrow oblong or obovate, ¾in.–½in. long, equidistant on stem, the lower petiolate; petioles long, ¾in.; the upper sessile, sheathing at base. Perianth pale-green, 1½in. long, rather narrow, very membranous,

slightly veined, segments not tailed. Dorsal sepal slightly acuminate, acute; lateral sepals connate, erect, acuminate, longer than dorsal; lateral petals nearly as long as dorsal sepal, acuminate, tips obtuse; tongue sub-linear-lanceolate, thickish, no veins visible, brownish-green, glabrous, produced, slightly recurved, tip sub-acute; appendage small, very short, slightly recurved, with a few short fimbriæ. Column rather short, length of tongue; wings broadly auricled, with two stoutish subulate acuminate horns arising from centre of wings and longer than column; stigma fimbriate at base.

Hab. Near Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Genus 15. **Thelymitra**, Forst.

1. *T. fimbriata*, sp. nov.

Plant rather slender, stem 11in. high, erect, flexuous. Leaves: basal 0; cauline 1, 3in. from base, sheathing, linear-acuminate, sub-acute, 6½in. long, ½in. wide at base, flat, sub-coriaceous, dark-coloured (with stem and bracts) when dry. Two large cauline bracts, equidistant, nerved, their tips very acuminate much produced and flexuous. Flowers 5, distant in a loose raceme, their pedicels ½in. long (the length of ovary); floral bract broadly ovate (almost sub-orbicular), 8–9 lines long, 5 lines wide, many-nerved, the top suddenly acuminate, acute. Perianth 1¼in. diameter, violet with darker pencillings, much veined; veins branching. Dorsal sepal broad; petals narrower than lateral sepals; lip longer and very narrow. Column truncate, with small toothed wings shorter than staminodia; staminodia largely fimbriate; fimbriæ spreading, irregular, flat, flexuous, sometimes forked at their extreme tips; anther ovate, pointed.

Hab. Open fern lands, interior; also in similar situations, Fortrose, Invercargill, whence specimen received in a packet: 1888.

Obs. A species having affinity with *T. pulchella*, Hook. f., but differing in its larger and otherwise-coloured flowers, its long narrow labellum, and remarkably fimbriate staminodia, &c.

Genus 18. **Orthoceras**, Br.

1. *O. caput-serpentis*, sp. nov.

Plant erect; root 2 large narrow-oblong tubers, 2in. long, sub-terete; stem slender, 18in. long, 1 line diameter above, green, rigid, wiry; 1 short broad basal bract, ¾in. long, acuminate. Leaves 2, near base, sheathing, 9in. long, very narrow, sub 1 line wide, sub-terete throughout, deeply channelled, margins closely involute, tip acute; 3 cauline leaves much shorter, distant, appressed. Flowers few (5), distant;

raceme short, 3in. long; pedicels 4–5 lines long, each with a green bract at base 1in. long, broadly ovate, ½in. wide near the base, much and suddenly acuminate, shorter than flower. Perianth open, gaping, sub-labiate; dorsal sepal concave, flattish, sub-orbicular, 5 lines diameter, shining, green without red-purple within towards base, obsoletely veined longitudinally, margins entire, thin, slightly incurved; lateral sepals 10 lines long, spreading, divergent at nearly right angles (*not upright*), thickish, narrow, wiry, 1 line wide at base, deeply channelled, margins conniving, purple-spotted, tip sub-acute; petals sub-oblong-ovate, 3 lines long, 2 lines broad at base, purplish, tips truncate, 3-toothed, sides not excised. Lip dark purple-red with a central bright-yellow longitudinal line, glabrous, 4 lines long, 3 lines broad at base, 3-lobed, lobes deeply cut, the 2 lateral erect, produced, sub-triangular-ovate dimidiate, obtuse, margins entire, thickened; the apical lobe much recurved, its tip rounded thickened and slightly concave, and a large rounded yellow callus at base its tip recurved, a minute colourless gland arising from base of labellum under the tip of the large yellow callus, no claw. Column green, acuminate, with thin yellow margins, the 2 appendages sub-linear, longer than column, curved, subulate, papillose, tips acuminate, acute. Anther broadly ovate, acuminate. Stigma large and with rostellum sub-quadrate-orbicular, much broader than anther. Ovary 8 lines long, narrow-oblong-clavate, slightly ribbed, ribs very obtuse; grass-green.

Hab. Open ground near River Moawhango, County of East Taupo; 1889: *Mr. H. Hill.*

Order X. RESTIACEÆ.

Genus 3. **Gaimardia,** Gaud.

1. *G. minima,* sp. nov.

A small glabrous and pale plant, main branch or rootstock horizontal, creeping under ground, stoutish, rooting and tufted from nodes, tufts pretty close; stems erect, sheathing; sheaths numerous, short, broadly ovate, striate, imbricate, appressed, tips thickened obtuse. Leaves 4–6 to each tuft, about ½in. long, $\frac{1}{50}$in. broad, erect and spreading, recurved longitudinally from vagina, wiry, somewhat harsh, sub-terete; tips sub-truncate, rounded; vagina broad, clasping, shining, striate, margins entire; ligula small, scarcely angled, minutely ciliolate; light-green when young. Peduncle terminal to tuft or branchlet, as long as the leaves, stoutish, striate. Capsule lanceolate, slightly convex on both sides, sub 2 lines long, smooth, shining, crustaceous, yellowish-ochraceous (somewhat resembling a small grain of *Phalaris canariensis*), tip obtuse, notched; stigmas 2, linear, $\frac{1}{10}$in. long, shaggy.

Hab. Dry open grounds, Mount Tongariro; 1889: *Mr. H. Hill.* Also, on high stony plains south of Dannevirke, County of Waipawa, hidden among low herbage; 1888: *W. C.*

Obs. I. A very small plant of densely-matted intricate flat growth, with only the upper portions of its tiny tufts and fruits appearing above soil. It seems pretty closely allied to the few (3) known and scattered species of this genus, though differing from them all: one (*G. setacea*) found at Port Preservation, South Island, by Lyall; one (*G. ciliata*) in Lord Auckland's Islands, by Hooker; and one (*G. australis*) in the Falklands, by Gaudichaud—this last-named species is also in Fuegia.

II. I have obtained several specimens from the matted lump of turf or sod containing them, cut out of the soil by Mr. Hill; but all the fruits were old or imperfect save two, which had retained their stigmata but no anthers.

Order XI. Cyperaceæ.

Genus 12. **Oreobolus**, Br.

1. *O. serrulata*, sp. nov.

Plant very small, densely cæspitose in close tufts, 1½in. high, erect, much and closely branched. Leaves subulate, 1in. long, erect, canaliculate, striate, sub-equitant, tips obtuse, margins throughout minutely and closely serrulate; pale-green when young, reddish in age; vagina very large, 2 lines wide, membranous, white, shining, its tips rounded produced and finely serrulate, 2-nerved on each side, nerves conspicuous, red; ligula 0. Culm shorter than leaves, cylindrical, smooth, wiry. Glumes 3, the outer and uppermost largest, its apical margin finely serrulate; the 2 floral ones margins entire, their tips obtuse slightly lacerate. Stamens 2 (in two flowers examined), long, flexuous, longer than style. Style long, filiform, straight, black, smooth; stigmatic branches 3, very long and flexuous, scabrid throughout, brown, not starting from one point. Scales 6, narrow triangular, acuminate, erect, persistent, white, their margins closely and finely serrulate. Nut small, under 1 line diameter, broadly pear-shaped, white.

Hab. Swampy ground at Rangipo, near the eastern base of Mount Tongariro, County of East Taupo; 1889: *Mr. H. Hill.*

Obs. This is an interesting little plant, making the third species of this small and curious genus found in New Zealand, which genus only now contains 4 species. It is also the smallest of them all, and is very distinct as a species in its finely-serrulate margins. One species (and the original type of the genus), *O. pumilio*, Br., was first detected by its describer in Tasmania; this species was also found by Sir J. D. Hooker in the Antarctic Islets, who at first described it as a sp. nov.,

O. pectinatus; and afterwards it was found by myself at Taupo and on the open summits of the Ruahine Mountain-range. A second New Zealand species, *O. strictus*, Berggren, was discovered by him near the River Bealey, South Island, and fully described, with admirable drawings and dissections, in his book of "New Species of New Zealand Phænogamous Plants," 1877. Another species, *O. obtusangulus*, Gaud., was early discovered by him in the Falkland Islands. Small though they all are, and in many respects very much alike, yet they all possess good distinctive characters; their study has afforded me great pleasure.

ART. LX.—*Notes on some New Zealand Ferns.*

By A. HAMILTON.

[*Read before the Hawke's Bay Philosophical Institute, 8th June, 1889.*]

THROUGH the kindness of Messrs. Pinckney and Robinson, of the Napier High School, I have the pleasure of bringing before you this evening some interesting specimens of ferns collected by them at Kuripapanga recently. The one of most interest, and which is probably new to most of us, is the second species of New Zealand *Gymnogramme.*

Gymnogramme pozoi, Kunze, var. *rutæfolia*, Br.

Many years ago Mr. Colenso, in one of his journeys along the coast to Wellington, found this little fern growing on the cliffs near Cook Strait. For a long time this was the only recorded locality in New Zealand, although the plant was known to occur over Australia, Tasmania, and in the Pyrenees. Within the last few years, however, it has been found in the Southern Alps at an elevation of about 3,000ft., and described by Mr. Potts, in vol. x., "Trans. N.Z. Inst.," as *G. alpina*, Potts. He remarks, it is probably the most densely villous of all the New Zealand Filices; in its soft woolly texture and silvery-grey colours it bears close resemblance to several plants from alpine flora. Compared with *G. pozoi*, it lacks the membranous texture of that rare fern, the fronds are crowded, the pinnæ far less distant.

The other specimens are forms of *Asplenium colensoi* and *A. hookerianum*, but of very lax growth, and certainly worthy of description as varieties.

V.—CHEMISTRY.

Art. LXI.—*Note on the Analysis of a Mineral Water from the Otira Gorge.*

By George Gray, F.C.S., Lecturer on Chemistry, School of Agriculture, Lincoln.

[*Read before the Philosophical Institute of Canterbury, 4th July, 1889.*]

The sample of water referred to in the present note was collected by the writer on the 21st January, 1889, in the Otira Gorge, from a spring which is stated to have been first discovered shortly after the earthquake of the 1st September, 1888. The spring is situated about three-quarters of a mile from the Otira Hotel, up the gorge, just below the road, and flows into the river-bed from the rocks forming the bank. In addition to the one from which the sample was taken, three other smaller springs formerly existed—two warm, and one cold; these, however, were covered up at the time by the shingle of the river-bed. The main spring flowed into a pool about 4ft. in diameter, the sides of which, and the surrounding shingle, were incrusted with a white deposit of sulphur. The smell of sulphuretted hydrogen was perceptible for some distance down the gorge, and it is stated that the same was noticed previous to the earthquake.

The temperature of the water was found to be 87° Fahr., while that of the river flowing by its side was 50° Fahr., and of a stream flowing into the river a little higher up the gorge, 46° Fahr. The temperature of the air at the time (7 a.m.) was 61° Fahr. The temperature of the spring is doubtless lowered by the proximity of the river-water, which flows close to it.

The appearance of the water was of a slightly-dark colour, but clear; the taste unpleasant, but after the removal of the sulphuretted hydrogen the water became palatable. Exposed to the air, a turbidity, due to separated sulphur, was produced; but after a short time this disappeared, and the water again became clear. No change was produced in the water by boiling other than an evolution of a portion of the

sulphuretted hydrogen. The reaction of the water was distinctly alkaline to cochineal solution. Specific gravity at 62° Fahr., 1·00022.

The quantity of dissolved mineral matters present was found to be low—only little more than 12gr. per gallon. The composition of the same is shown by the following analysis:—

	Parts per Million.	Grains per Gallon.
Potassic oxide	2·59	0·181
Sodic oxide	63·74	4·462
Calcic oxide	11·48	0·804
Magnesic oxide	1·98	0·139
Ferrous oxide	Trace	Trace
Alumina	3·00	0·210
Sulphuric anhydride	34·33	2·403
Phosphoric anhydride	Trace	Trace
Silicic anhydride	47·20	3·304
Carbonic anhydride	9·36	0·655
Chlorine	3·50	0·245
Sulphur, as SH_2	2·82	0·197
Totals	180·00	12·600

These results may theoretically be arranged as follows:—

	Parts per Million.	Grains per Gallon.
Potassic sulphate	4·79	0·335
Sodic sulphate	57·03	3·992
Sodic chloride	5·74	0·402
Sodic sulphide	6·45	0·452
Sodic silicate	60·89	4·262
Calcic silicate	4·86	0·340
Calcic carbonate	16·32	1·142
Magnesic carbonate	4·15	0·291
Alumina	3·00	0·210
Free silicic anhydride	14·76	1·033
Totals	177·99	12·459

The total sulphuretted hydrogen in the water amounted to 11·8 parts per million, equal to 0·826gr. per gallon. Of this, 2·8 parts per million were in a combined form. Ammonia salts were present to the extent of 0·87 part per million, reckoned as ammonia, while albuminoid nitrogen, or that existing in an organized form, amounted to 0·18 part per million. Only a trace of nitrates existed, not sufficient for determination. No iodine or bromine was detected. The quantity of water available for testing for these elements, however, in consequence of an accident to one of the bottles in transit, was not sufficient to prove their absence with absolute certainty. A spectroscopic examination showed the absence of lithium.

From the results obtained this water might be termed siliceous and sulphurous. It is essentially different from the water from the Hanmer Springs, and pertains more to the character of the waters of the Rotorua district, reported on by

Mr. Skey in the "Trans. N.Z. Inst.," vol. x., p. 432. It differs, however, from these waters in having only a portion of its carbonic anhydride replaced by silica, and in containing less dissolved matter. The water doubtless possesses therapeutic properties, and the springs might, if means could be adopted to protect them from shingle and the influx of river-water, prove of value, situated as they are among such sublime scenery.

I.—MISCELLANEOUS.

[CONTINUED.]

ART. LXII.—*On the Korotangi, or Stone Bird.*

By Major WILSON.

Communicated by Edward Tregear, F.R.G.S.

[*Read before the Wellington Philosophical Society, 17th November, 1887.**]

THIS paper has been promised for so long that we were at last facetiously asked "when the Korotangi would sing." We make no excuse for the lengthened silence, but beg to offer an apology therefor.

The Korotangi is the name given to a stone bird said by the Maoris to have been brought from Hawaiki by them in their canoe Tainui. The bird measures 10¼in. from point of beak to tip of tail. The right half of the tail is broken, a circumstance not mentioned by the late Sir Julius von Haast in his paper on this subject.† The weight of the bird is 4lb. 10oz.

We give the scientific description of the Korotangi from the said paper.

"It is carved," Sir Julius writes, "out of a very dark green serpentine, according to a calculation made by Mr. G. Gray, of a specific gravity of 2·531 at 60° Fahr., which is about the mean of a series of this mineral, of which the specific gravity has been ascertained by other mineralogists. The bird, carved in a bold and careful way and in a natural position, seems to represent at first glance a species of *Prion*, the beak being so very much depressed; but on closer examination it will be seen that it does not possess the united nasal tubes placed on the top of the bill, but has the nostrils lateral near the base of the beak, as in the ducks; but it is very possible that it might be only a conventional form. . . .

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* The printing of this paper was delayed, with the consent of the author, for the reasons stated in the Proceedings of the Wellington Philosophical Society, 31st July, 1889 (*post*).

† "Trans. N.Z. Inst," vol. xiv., p. 104.

"I exhibit at the same time, from the museum, an ancient Japanese bronze, without doubt a vessel for burning incense, representing also a bird, the character of which is in many respects not unlike the specimen carved from stone. In both, the feathers on the back are rounded, with a central line from which smaller lines slope downwards on both sides; while the wing-feathers are more pointed, and have a similar ornamentation.

"To my mind there is no doubt that both have a somewhat similar origin, and come either from the same eastern country, or, if from two different countries, that the latter are nearly related to each other, and where for many centuries, if not thousands of years, industrial art has been practised."

The Maoris assert that they brought the Korotangi with them from Hawaiki, and that it came in the canoe called "Tainui," which first landed on the east coast; but it was dragged over the Tamaki portage into Manukau, thence navigated to Aotea, on the west coast, between Raglan and Kawhia.

It is a curious fact that the Korotangi was found in a *rua*, or hole, in which was growing a large kahikatoa-tree (manuka), very old. The tree had been blown down, and the bird was found in the roots by a Maori. It is owing altogether to this fortuitous circumstance that we know anything of this interesting relic of native antiquity. Mr. Albert Walker procured the stone bird, and left it for a short time with Major Drummond Hay, in Cambridge. It was in his house that an old chieftainess saw it, and on hearing where it was discovered she bowed herself, and then sang the song relating to it which Te Ngakau (usually called the King's Secretary) afterwards wrote for me. This song is known in all parts of the country. I received a copy even from Rotorua. In this manner, then, was this made known. The knowledge of its having been found caused much excitement amongst the natives. Tawhiao, the Maori King, came to see it, and Rewi took it away with him, and rose several times through the night to tangi, or cry, over it.

We now give the song relating to the Korotangi in Maori, and a translation by the late C. O. Davis, the well-known native scholar:—

"Kaore te aroha
Ki taku nei manu,
Titoko tonu ake,
I te ahiahi
Ka tomo ki te whare,
Taku ate noa ai.
He rangi au ka tatari,
Apopo (akuanei)
Awhea ano te hiki mai ai?

Kei hea Korotangi
Ka ngaro nei?
Tena ka riro kei te katokato,
I te rau powhata.
Nga whakataine
Tu mai ko te Po ko te Ao,
Ka oho au, tirohia
Iho e hine ma;
Nga parera e tere ake na;
Ehara anake
He parera Maori
Waiho me titiro
Ki te huruhuru,
Whakairoiro mai,
No tawhiti, e waiho
Ana koe hei tiaki-hanga,
Hei korero taua
Ki tona taumata.
I puea koe,
I te huahua,
Koewaewa wai
Ki Rotorua
E ai te ui ake
Ki a Kawatepuarangi."

TRANSLATION BY THE LATE C. O. DAVIS.

"Keen is the sorrow, O my bird, for thee!
And, when the evening closes in, I look
Around in vain for thee, then turn
Into my dwelling. Oh! the pang
Of heart I feel when there! I wait the live-long day
In restlessness; I wait another day,
And morrow comes! When, when wilt thou return
To me? *Where is Korotangi absent?*
Ah, how long he has gone to feast on leaves
Of kale!—gone, gone to his amusements.
I wake when time divides in twain the day
And night. My daughters, look ye on the ducks
Down in the distance floating. Ah! these are
Not like him; that is the common bird.
Let us gaze upon the feathers carved
In lands remote. Ah! thou wert rudely thrust
From fish preserved in unrich fluid
Taken from Rotorua's lake. Thou wert
The guardian of our treasures, and the theme
Of many conversations on many heights
Of numerous village homes. Now what remains?
We'll ask for thee of Kawatepuarangi."

Kawatepuarangi was an ancestor of the Ngatipikiao Tribe—most likely a notable *tohunga* or priest.

Te Ngakau has written, in the song, "Ehara tena he manu Maori waiho, me titiro ki te huruhuru whakairoiro mai, no tawhiti;" which we translate, "This not a Maori bird. Consider—look at the carved feathers thereof. It (evidently) comes from a distance—a foreign country, or over the sea."

Here is another song, as furnished by Te Ngakau:—

WAIATA KOROTANGI.

"Kaore taku raru,
I pongia au ki te haere,
Te ata whakake,
Ko a te hua pea,
Parewhakaika. Ka kore
I te tinana, ko te
Numanga, ko te kanohi,
Te ahoaho nunui,
No Tokoahu kihai
Rawa i tirohia atanga
Tu noa, ho ake te reo
Kia puaki, e kore ra,
E matea nei roto
Kei te ake taku rangi
Te haumaruru;
Na Koro i homai,
Ka kite au i a Te Hiku;
Mau hikuhiku ai,
Te napenga o te reo;
He rau tahuritanga,
Kia horomia te huwhare,
I kai-a-kawhi kau,
Ki te tauranga,
Ka tuku atu ai au, e, i."

TRANSLATION BY C. O. DAVIS.

"Trouble has now o'ertaken me, for I
Had wandered far, on thy account, perhaps,
O Parewhakaika. I do not see
Thee now in person; nor did I see thee
Passing from my view, nor even was thy
Countenance in sight. The great ancestral
Line of Tokoahu has found no favour
Standing here; the voice was heard in loneliness.
Ah! I will not show my inmost yearnings,
Lest I wear upon my aching brow
The griefs and care I feel. *'Twas Koro's gift
To me;* and then Te Hiku I descried,
But glances only of him in the distance;
I toss and turn a hundred times, and strive
In vain to moisten my parched palate.
A passing glance was all I had of him
As he embarked, and then I let him leave."

One cannot clearly observe the connection of this song with Korotangi, unless it be the lament of the original owner, who gave it to the departing emigrants. "'Twas *Koro's* gift to me," he cries; Koro being, possibly, a great chief in Hawaiki. And again, "A passing glance was all I had of him as he embarked, and then I let him leave," would almost point to our surmise.

The following is from Sir George Grey's collection of Maori poems published in 1853, and is entitled "He Tangi, na Rotorua." There is no doubt that it refers to our subject, though the word "Korotau" is used instead of "Korotangi;" but the copy I have from Rotorua—"Na Ngatipikiao"—calls it Korotangi. Sir George Grey's book was published, it may be noted, some nineteen years before the bird was found.

The song as given by Sir George Grey, page 235, is as follows:—

"Kaore te aroha ki taku potiki,*
Tuhana tonu ake, i te ahiahi,
Ka tomo ki te whare, taku ate kau ai:
Tirohia iho, e hine, ma ki te parera e tere atu na
Ehara tena he manu maori,
Me titiro ki te huruhuru whakairoiro mai no tawhiti,
Kei whea Korotau, ka ngaro nei?
Tena ka riro, kei te kato kai,
Ki te rau pohata, nga whakangaeore;:
Tunui me te po, ka oho au;
E waiho ana koe hei tiaki hanga,
Hei korero taua, ki tana taumata,
He oti te huri atu, ko Kawatapurangi."

Maori poetry, unlike their prose, is often most difficult to understand, the meaning of many of their older poems being only well known to the aged *tohungas*. The difficulty here noted may be gathered from Dr. Maunsell's remarks on Maori poetry, as quoted by Sir George Grey. He writes: "In observing the construction of Maori poetry we shall see that it is not only abrupt and elliptical to an excess not allowed in English poetry, but that it also carries its license so far as to disregard rules of grammar that are strictly observed in prose; alters words so as to make them sound more poetically, deals more arbitrarily with the length of syllables, and sometimes even inverts their order or adds other syllables."

Knowing Dr. Maunsell to be so exceptional in the ability to translate Maori poetry, we were particularly anxious to submit the foregoing songs for his criticism. He very kindly made the following translations, which differ considerably from those of C. O. Davis, who made the first and second already given:—

* "Kaore te aroha ki taku potiki." The word *potiki* or "grandchild" is here used instead of *manu* or "bird;" but *potiki* is often used for "pet," and *manu* likewise for *potiki*. A mother lamenting the death of her child would cry, "Kua rere taku manu kiwhea?"—Whither has my bird fled? Even adults for whom great affection is felt may in their songs be designated as *manu*. We consider in the instance before us that *manu* and *potiki* are convertible terms.

First Song.

"Great is the love
To my bird;
It moves in me
In the evening,
Into the house enters
My liver heedlessly.
A day I wait,
To-morrow, this day.
When will it lift [its foot] hither?
Where is Korotangi that has been missing?
It is gone to clip the leaf of the powhata.
The Whakataines [mountains?]
Stand before me day and night.
I stir myself; look, woman!
The ducks that swim below these
Are not it by any means—
They are Maori ducks.
Stop! we must look at the feathers
Brought here, carried
From a distance.
You are left
To take charge of property
As a subject of talk for the [hostile] band.
On its hill-brow
You rose above
The *huahua*
For mixing water
In Rotorua,
So that one may ask
For Kawatepuarangi."

Third Song. (From Sir George Grey's Collection.)

"Great is the love to my babe
That glows within, in the evening.
I enter the house myself alone.
Look, girl, at the duck that swims there.
It is naught. It is a Maori duck.
We must look at the feathers that
Have been carved and brought from a distance.
Where is Korotau who is missing?
He is gone. He is clipping food
From the leaf of the powhata.
The Whakangaeroes [mountains?] stand large
As night.
I stir up.
You have been left to take care of property
As a subject-talk perhaps for
The [hostile] band on the hillside.
I turn away—here is Kawatapurangi."

Archdeacon Maunsell adds, in a note, "I have translated literally the first and third songs; they are particularly interesting to me as illustrating the causes of coincidences and variations of some of the Psalms in the Bible." "A very intelligent Maori," he continues, "to whom I submitted the second song, gave it up in despair. It is a question whether it

has been correctly written. . . . Line 20, 'He e au,' has some error in it." Here, however, Dr. Maunsell misread our writing. We wrote "He rau" (a hundred), not "He e au" —a hundred turnings, or tossings (in the night), being the correct reading. No wonder, then, the intelligent Maori "gave it up in despair."

The allusion to Rotorua in the song first given is better understood when the assertion of the natives, notably that of Rewi and Te Ngakau, is considered, that the Korotangi was stolen ages ago, and, presumably, carried to Rotorua.

To our mind there is no doubt that the bird was hidden or deposited where it was found; placed there possibly for safe-keeping much in the same way that the bodies of renowned chieftains were conveyed out of the ken of the vulgar, and known only to the old *tohungas* appointed to the service. It would have been considered a calamity if such a famous relic as this should have fallen into the hands of aliens. Indeed, the Korotangi was nearly being placed in the same position as the bronze Bacchus recently rescued from the bed of the Tiber, where it had lain for centuries.

Mrs. Wilson, the owner of the stone bird, was strongly urged by Te Ngakau to cast it into the depths of the Waikato River for fear she would suffer *makutu*—or bewitchment—at the instance of envious persons, who themselves wished to become possessed of the treasure, the chief Rewi being particularly feared in this direction. Indeed, her death is, by some, ascribed to *makutu* on this account. We can very well, then, judge of the anxiety to have the Korotangi placed where there would be little likelihood of its falling into obnoxious hands, and can understand the rumour set afloat of its having been stolen and spirited away to Rotorua or elsewhere. Many famous tribal heirlooms are thus hidden and lost to posterity. The Rev. Mr. Buller mentions a famous *taiaha,* of great *mana,* as having been buried and lost in this way lest it should fall into the power of opposing tribes and cause disaster to the original owner.

Mr. Colenso has a Tamil bell, discovered buried at Taupo, which must have arrived in much the same circuitous manner as our subject, clearly pointing to a similar eastern origin.*

In the first migrations of the Maoris hither, they, like their more civilized brethren, doubtless brought all they could with them of their "household gods," of their *mokai* or pets. Mr. C. O. Davis writes, "If tradition is to be relied on, each vessel of the fleet brought to these shores some lasting monuments of ancient art." We note in this direction the two stone images, rudely enough formed, which were brought

* "Trans. N.Z. Inst.," vol. iv., p. 40, pl. ii*a*.

from over the sea. One of these named Taukata, which was landed at Whakatane, came in the canoe Matatua; and to save this prized memorial of Ngatiawa, it was secreted in the earth—in the same way, undoubtedly, as was the Korotangi—cognizant only to the priests of the tribe. The other stone image named Matuatonga came in Te Arawa canoe, which landed at Maketu, in the Bay of Plenty. "This sculptured treasure was removed to Rotorua-nui-a-kaha, about forty miles from the coast, and finally deposited on the sacred island of Tinirau"—Mokoia, in the centre of Lake Rotorua—"where it lay beneath the soil, hard by the hot bath of the celebrated Maori beauty Hinemoa, who flourished in the ninth generation after the landing at Maketu." Sir George Grey has in his fine collection a small stone figure presented to him by the Rotorua chiefs. These images may have been sculptured by the ancient Maoris in their old home across the sea; but they present nothing of the artistic design and finish of the Korotangi. The position of the bird is so natural that even a Canova need not have been ashamed to claim it as a conception of his genius.

The Korotangi, its history and appearance, naturally suggests the whence of the Maori, all indicating his extreme eastern origin—speaking from a European standpoint. But as this monograph deals simply with the subject before us—the stone bird, to wit—we leave the more important and extraneous discussion of the origin of these people to others; and, perhaps, on some other occasion, to ourselves. Meanwhile, we fondly hope this paper may meet with the approval of the members of this honourable Society.

Note by Edward Tregear, F.R.G.S.

On account of my deep interest in the study of Maori (*i.e.*, Polynesian) dialects and antiquities, Major Wilson very kindly allowed me to become the medium through whom his valuable paper on the Korotangi has been presented to the Society. The writer has told us how highly this stone bird, this beautiful work of art, was valued by the Maoris; that it had been probably brought across the sea from afar; been lost; bewailed in ancient songs; found in the upturned roots of a fallen tree, and wept over by great chiefs with pathetic lament. It is a point of great interest to consider whether any mention of the name of this bird can be found outside New Zealand among the other inhabitants of the South Seas. I believe that the word *Korotangi* is connected in some way with the Polynesian traditions of the Deluge, and quote the following as evidence. In the Marquesan Flood-legend, an ancient song, above suspicion of having been either com-

posed or tampered with in modern times, the singer states, after noticing the gathering-together of the animals in couples and their entry with the chosen men into the life-saving vessel, the destruction of the whole visible world by water, the Lord Ocean commanding the dry land to appear:

> "Returned is the north wind with the . . .
> Not found is a place whereon to alight."

Unfortunately, the missing word at the end of the first line (in Marquesan *hafa*), has found no translator, but, from the allusion to no place having been found whereon to alight, it is probably connected with the sending-forth of the dove or raven as "the traveller of Tangaroa." In Samoan legend, Tangaroa sent his daughter (in the shape of a bird) down from heaven. She returned to him, and reported that she could find nothing but breaking waves. She was sent again and again, till at last the land appeared. Next, it will be remembered that, although the Fijians are not members of the fair Polynesian race, yet their speech has preserved many Polynesian words in great purity, and that it is believed by Fornander and other authorities that the Polynesians inhabited Fiji before their dispersion to the different islands. From the work of the Rev. Thomas Williams ("Fiji and the Fijians," p. 196) I make the following quotation:—

"They speak of a deluge, which according to some of their accounts was partial, but in others is stated to have been universal. The cause of this great flood was the killing of Turukawa—a favourite bird belonging to Ndengei—by two mischievous lads, the grandsons of the god. These, instead of apologizing for their offence, added insolent language to the outrage, and, fortifying, with the assistance of their friends, the town in which they lived, defied Ndengei to do his worst. It is said that, although the angry god took three months to collect his forces, he was unable to subdue the rebels, and, disbanding his army, resolved on more efficient revenge. At his command the dark cloud gathered and burst, pouring streams on the devoted earth. Towns, hills, mountains, were successively submerged; but the rebels, secure in the superior height of their own dwelling-place, looked on without concern. But when at last the terrible surges invaded their fortress they cried for direction to a god, who, according to one account, instructed them to form a float of the fruit of the shaddock; according to another, sent two canoes for their use; or, says a third, taught them how to build a canoe and thus secure their own safety. All agree that the highest places were covered, and the remnant of the human family saved in some kind of vessel, which was at last left by the subsiding waters on *Mbenga*; hence the Mbengans draw their claim to stand

first in Fijian rank. The number saved—eight—exactly accords with the 'few' of the Scripture record. By this flood it is said that two tribes of the human family became extinct. One consisted entirely of women, and the other were distinguished by the appendage of a tail like a dog. The highest point of the island of Koro is associated with the history of the Flood. Its name is *Ngginggi-tangithi-koro*, which conveys the idea of a little bird sitting there and lamenting the drowned island. In this bird the Christians recognize Noah's dove on its second flight from the ark. I have heard a native, after listening to the incident as given by Moses, chant '*Na Qiqi (Ngginggi) sa tagici (tangithi) Koro ni yali*'—'The Qiqi laments over Koro because it is lost.'"

I believe that this quotation establishes some connection between the word "Korotangi" and the bird which wailed (*tangi*) over *Koro*. When we also find that in Samoan the word which corresponds to *Koro* means "to coo, as a dove," and in Hawaiian is "to make a great sound of wailing, as of many wailing together," and also "to roar and rush as the sound of water," the connection of *Koro* with the Deluge legends appears unmistakable. If this stone carving is a representation of the bird of Chaldean and Hebrew Flood-tradition, it is probably of immense antiquity (perhaps brought even from the very source of Deluge-stories in far-off Asia): it may be quite the oldest relic of primitive men and their beliefs now in existence.

NEW ZEALAND INSTITUTE.

NEW ZEALAND INSTITUTE.

TWENTY-FIRST ANNUAL REPORT, 1888–89.

DURING the past year Board meetings were held on the following dates: 23rd July, 1888; 15th January, 17th January, 11th February, 27th February, and 14th May, 1889.

The members elected by the incorporated societies for the year are—Mr. J. McKerrow, F.R.A.S.; Mr. W. Maskell, F.R.M.S.; and Mr. A. S. Atkinson, F.L.S.

The members now on the roll of the Institute are—

Honorary members	30
Ordinary members—	
Auckland Institute	216
Hawke's Bay Philosophical Institute ...	104
Wellington Philosophical Society ...	253
Philosophical Institute of Canterbury ...	108
Nelson Philosophical Society	36
Westland Institute	78
Otago Institute	140
Southland Institute	72
Making a total of	1,037

The volumes of "Transactions" now in stock are—Vol. I. (second edition), 275; Vol. V., 33; Vol. VI., 30; Vol. VII., 126; Vol. IX., 127; Vol. X., 160; Vol. XI., 47; Vol. XII., 53; Vol. XIII., 52; Vol. XIV., 75; Vol. XV., 187; Vol. XVI., 190; Vol. XVII., 225; Vol. XVIII., 170; Vol. XIX., 195; Vol. XX., 200; Vol. XXI., not yet fully distributed.

The Volume XXI. was issued in May last, and contains 60 articles; also addresses and abstracts of articles which appear in the Proceedings. The volume contains 583 pages of letterpress and 36 plates.

The following is a comparison of the contents with those of the previous year's volume:—

	1889. Pages.	1888. Pages.
Miscellaneous	114	80
Zoology	148	140
Botany...	120	116
Chemistry	15	—
Geology	84	96
Proceedings	48	47
Appendix	54	49
	583	528

The expense of printing Vol. XX. of the "Transactions" amounted to £415 10s. for 528 pages, and that of Vol. XXI. to £248 11s. 4d. for 583 pages, the printing for the latter having been done under a fresh contract.

The statement of accounts for the year by the Honorary Treasurer is appended, and shows that there is a balance in hand of £95 14s. 11d.

JAMES HECTOR,
Manager.

Approved by the Board.
W. B. D. MANTELL,
Chairman.

5th August, 1889.

NEW ZEALAND INSTITUTE ACCOUNTS FOR 1888–89.

Receipts.	£	s.	d.	*Expenditure.*	£	s.	d.
Balance in hand on 23rd July, 1888	130	4	9	For printing Vol. XXI...	248	11	4
Grant by Parliament, 1st Dec., 1888.. ..	500	0	0	For extra volumes printed by Messrs. Lyon and Blair	60	5	0
Contribution from Wellington Philosophical Society, 24th Feb., 1889	24	17	0	Miscellaneous items ..	25	10	6
				Transfer to account for printing memoirs (see resolution, 13th May, 1885; report, 1885–86; and minutes, 5th Aug., 1889)	125	0	0
				Transfer to liability account for printing postponed papers	100	0	0
				Balance in hand ..	95	14	11
	£655	1	9		£655	1	9

W. T. L. TRAVERS,
Honorary Treasurer.

PROCEEDINGS.

WELLINGTON PHILOSOPHICAL SOCIETY.

First Meeting: *12th June, 1889.*

A. de B. Brandon, President, in the chair.

New Members.—E. Samuell, Robert Evenden, H. B. Vogel, and F. W. L. Kirk.

Inaugural address by the President, A. de B. Brandon, B.A.

Abstract.

The President thanked the Society for the honour they had done him in electing him to the office of President, and promised that he would fulfil its duties to the best of his abilities. He referred feelingly to the death of Mr. James Coutts-Crawford, F.G.S., one of the original members of the Society, and to the great loss they sustained by the decease of such an able and energetic working member as Mr. Crawford had been. The Society on the 10th instant, he said, completed the twenty-first year of its incorporation with the New Zealand Institute; and he expressed a hope that as an adult it would continue to be as progressive as it had been in its youth. Members would shortly be asked to give their attention to the practical development of the scheme recently proposed by Mr. Maskell, the success of which would of course depend largely upon their exertions. There was, however, no reason to suppose that the result would not be in every way successful; and doubtless before long the medals of the Society would be regarded as prizes to be eagerly sought after. Vol. xxi. of the "Transactions of the New Zealand Institute" had just been published, and, as usual, the subjects dealt with ranged over a very wide field. Having referred in eulogistic terms to papers by Messrs. Maskell and Colenso, the President said,—A short paper on the *Apteryx bulleri* comes from the pen of Mr. R. Bowdler Sharpe, F.L.S., &c., in which he states that, during an examination of some skins of *Apteryges* in company with Sir Walter Buller, he became firmly convinced that the ordinary brown *Apteryx* of the North Island is certainly specifically distinct from the *Apteryx australis* of the South Island; and he was a little surprised to find, on going over the literature of the subject, that, notwithstanding a similar verdict on the part of such excellent naturalists as Sir James Hector, Sir Julius von Haast, Professor Hutton, Mr. Potts, and others, the North Island bird had not yet received a name. The author then proceeds to say that it has generally been called by naturalists *A. mantelli*, of Bartlett, and that it is the *A. australis*, var. *mantelli*, of Finsch's paper in the "Journal für Ornithologie," 1873. He then asserts that the characters given by Mr. Bartlett for his *A. mantelli* are founded on the natural variations of *A. australis*, "of which *A. mantelli* is a pure synonym," and says that the North Island *Apteryx* awaits a name. Having thus stated that a nameless bird has been known by a name, but that this name belongs to another bird which has another name, the author proceeds to discover that there are differences between the nameless bird and the other bird, and, at the sug-

gestion of Dr. Finsch, he names as *A. bulleri* what was heretofore known as *A. mantelli.* It is interesting to examine the literature of the subject now in the possession of this Society, to see whether Mr. Sharpe's assertion that the North Island kiwi has no name is founded on fact, and I will proceed to give you some extracts from papers which have from time to time been published in the "Transactions" and by the Geological Survey Department:—1868, "Transactions," vol. ii., p. 67: Mr. T. H. Potts writes, "No. 63, *A. mantelli*, Kiwi. This is usually known as the kiwi of the North Island." 1871, "Transactions," vol. iii., p. 52: Sir Walter Buller wrote,—

"On the 10th December, 1850, a series of specimens was exhibited before the Zoological Society of London, when Mr. Bartlett pointed out characters which, as he contended, established the existence of two species hitherto confounded under the specific name of *Apteryx australis* ('Proc. Zool. Soc.,' 1850, p. 276). Mr. Bartlett stated, at this meeting, that, an *Apteryx* belonging to the late Dr. Mantell having been placed in his hands by that gentleman, he had remarked its dissimilarity to ordinary examples, and that after a careful comparison with a number of other specimens he had come to the conclusion that it was a new species. On comparing Dr. Mantell's bird, however, with the original specimen in the Earl of Derby's collection, he found that they were identical. He accordingly referred his supposed new species to *Ap. australis*, and distinguished the more common bird as *Ap. mantelli*—'a humble effort,' as he says, 'to commemorate the exertions of Walter Mantell, Esq., to whom we are indebted for so many valuable discoveries in the natural history of New Zealand.' The characters which distinguish it from Shaw's *Ap. australis* are—'its smaller size, its darker and more rufous colour, its longer tarsus which is scutellated in front, its shorter toes and claws which are horn-coloured, its smaller wings which have much stronger and thicker quills; and also in having long straggling hairs on the face.'

"Mr. Bartlett stated, further, that the *Apteryx* belonging to Dr. Mantell was collected by his son in Dusky Bay, whence the original bird, figured and described by Dr. Shaw, was also obtained, and that, so far as he had been able to ascertain, all the known specimens of *Ap. mantelli* were from the North Island.

"In a 'Report on the Present State of our Knowledge of the Species of *Apteryx*' by Drs. Sclater and Hochstetter, read at a meeting of the British Association in September, 1861, and published for general information in the *New Zealand Gazette* in May, 1862, the following observation occurs respecting *Ap. australis*: 'In fact, the species is so closely allied to the *Ap. mantelli* as to render it very desirable that further examples of it should be obtained, and a rigid examination instituted between the two. For the present, however, we must regard this form of *Apteryx* as belonging to the southern portion of the Middle Island.'

"Mr. Gould, in the Appendix to his 'Handbook to the Birds of Australia,' p. 568, retains the original name for this species, but remarks, 'If Mr. Bartlett's view be correct, it is probable that the bird figured by me is the one he has named *Ap. mantelli.*'

"In my 'Essay on the Ornithology of New Zealand, 1865' ('Trans. N.Z. Inst.,' vol. i.), I stated that only two examples of *Ap. australis* had been recorded (those noticed above); but Dr. Otto Finsch, in his review of my essay ('Journal für Ornithologie,' 1867, p. 331), observes: 'Our knowledge of *Ap. australis*, Shaw, is not confined to the two examples referred to by Mr. Buller. The Leiden Museum possesses one also, and there is a very fine specimen in the Imperial collection at Vienna.'

"Never having seen the four examples of *Ap. australis* thus mentioned as existing in European collections, I cannot presume to offer any positive opinion respecting them; but having examined a large series of

specimens in New Zealand, some forty in number, of all ages, and collected from all parts of the country, I have no hesitation in saying that (excluding, of course, the well-known *Apteryx owenii*) all of them are referable to one and the same species. Having also carefully inspected the drawings illustrative of the specific distinctions between *Ap. australis* and *Ap. mantelli* ('Proc. Zool. Soc.'), and examined the characters on which Mr. Bartlett grounded his new species, I am strongly of opinion that it will be found necessary to drop *Apteryx mantelli* as a species, and to refer all the examples thereof to the true *Ap. australis*."

1871, "Catalogue of the Birds of New Zealand," by Hutton, p. 23: "58. *Apteryx australis*. . . . Greyish-brown streaked with black, feathers soft to the touch. . . . . South Island and Chatham Islands (?). 59. *Apteryx mantelli*, Bart. Rufous-brown streaked with black, feathers harsh to the touch. North Island, Little Barrier Island." 1872, "Transactions," vol. v., p. 194: Mr. Potts discusses Mr. Buller's views given in vol. iii., and writes, "We have no hesitation in maintaining that the plumage *alone* presents sufficiently marked characteristics for the retention of the two species;" and refers to the distinction pointed out by Captain Hutton. Mr. Potts then says, "The nut is cracked at a blow. The feathers which clothe the southern bird are produced into soft hair-like points; the hand passed over the plumage against the lay of the feathers encounters an almost downy softness; when compared with a similar test applied to the covering of *A. mantelli* it might be fairly so termed. The reason is obvious—the feathers of the latter species are produced into hair-like points of almost bristly stubbornness. This contrast in the character of the plumage is distinguishable in the young state." 1874, "Transactions," vol. vi., p. 118: Sir Walter Buller writes on *Apteryx mantelli* as follows: "Dr. Finsch states that 'after careful and repeated examination' of several specimens from both islands he is unable to admit *A. mantelli* (of the North Island) to the rank of a distinct species; but he proposes to distinguish it from the South Island form as '*A. australis*, var. *mantelli*, Bartl.' This opens up again the old *quæstio vexata*, 'What is a species?' The amount of difference necessary to constitute a 'species' in the generally-accepted sense is not capable of definition, ... and it is sufficient for my argument that Dr. Finsch recognizes constant characters in the North Island bird of a kind to distinguish it as a permanent 'variety.' I may add that I had the satisfaction of submitting good specimens of *Apteryx australis* and *Apteryx mantelli* to Professor Newton, Dr. Sclater, Mr. Salvin, and Mr. Sharpe, all of whom were decidedly of opinion that the characters relied on were of sufficient importance to warrant the separation of the species." These extracts show beyond doubt that the brown kiwi of the North Island was known as *A. mantelli*, and the only question at issue was whether it was a species distinct from, or merely a variety of, *Apteryx australis*. Further, the characters now relied on as distinguishing *A. mantelli* as a species were known and recognized eighteen years ago, and Mr. Sharpe himself some fifteen years ago pronounced in favour of *Apteryx mantelli*, the brown kiwi of the North Island, being a separate species. He now comes to the same conclusion, and we can only hope that the change in name is made merely in the interests of science. To me it seems that the change in name is wholly unwarranted, and that Mr. Sharpe's proper course was to have confirmed his former opinion that *A. mantelli* was a distinct species. It may be suggested that the type-bird from which Mr. Bartlett established and described the species *A. mantelli* was in reality a variety of *A. australis*, and not a North Island kiwi; but in Sir Walter Buller's paper in vol. iii. we are informed that Mr. Bartlett had before him a series of specimens, and had also had an opportunity of examining the original type-

specimens of *A. australis*, and there is no suggestion that any specimen of *A. australis* has been discovered which truly answers to the description of the *A. mantelli* of Bartlett. In any case, however, the general acquiescence of ornithologists for the last thirty years in assigning the name *A. mantelli* to the North Island kiwi should have been regarded by Mr. Sharpe as an authority, if not a positive direction, for retaining it when definitely separating the species. I cannot help expressing the opinion that Sir Walter Buller should not readily have allowed his judgment and skill as an ornithologist to be impeached, although the result of the impeachment is to add one more to the list of species in which his name will be handed down to posterity in a Latinized form. In naming their discoveries, explorers, scientific or otherwise, are at times capricious, and had any change of name been at all necessary a more euphonious and characteristic substitute for *A. mantelli* could have been devised than *A. bulleri.*—The President commended to the careful perusal of members Mr. Higginson's paper on "Sanitary Sewerage." The future of Wellington could not be foretold, but they all hoped and must assume that there would be a great increase of trade and population; and all works of a permanent nature ought to be constructed with a proper regard to such increase. Unfortunately, any great reform was often met with the objection which might be briefly put as "What we have got is good enough for us: let posterity look after itself." What now existed as sewerage might even be good enough for the present, but it certainly would not be enough for twenty years hence. He suggested, however, that immediate reform was necessary. The difficulty to the reformer lay in the ignorance of the average burgess of even elementary science. He would listen to what you had to say of the importance of reform, but you had an uncomfortable feeling that you might talk Greek to him with the same effect. This difficulty must be met by pressing the subject upon the people till they recognized its value; and he urged members of the Society, who were better able to appreciate the subject, to assist in doing that. In conclusion, the President said he had not ventured to give members a review of the history of science for the past year, but would do so at the end of his term of office.

Sir James Hector moved a hearty vote of thanks to the President for his address. He expressed the pleasure it gave him to find the younger members of the Society coming forward and taking their share in the work. Judging by the address which they had just heard, the Society would have no reason to regret having elected Mr. Brandon President. Touching the paper on the *Apteryx*, he was delighted to find legal acumen brought to bear on the mysteries of science. What the President had said would be read with great interest by naturalists, by some of whom, no doubt, it would be resented, although on the whole it would do good. Sir James went into the subject at length, and finally expressed an opinion that Mr. Sharpe was not right in his contention that the North Island kiwi had not previously been named, as, according to Gould, Mr. Bartlett had founded *A. mantelli* not on a specimen collected in the south by Mr. Mantell, as Mr. Sharpe suggests, but on an undescribed and unnamed specimen from the North Island which he discovered in a private collection in England.

Mr. Chapman seconded the motion for a vote of thanks. He said that the kiwi in question was certainly known as "*mantelli*," and the reason given for the alteration was a mere quibble.

Mr. Maskell warmly supported the motion. With respect to the *Apteryx bulleri*, he thought it was a question whether in any future Latin dictionary schoolboys would not have to look out "*Bulleri*," and find it set down as a word identifying any bird, beast, or fish found in New Zealand. Sir Walter Buller had so many things attached to him, and had received so many evidences of the extreme appreciation of his Sovereign and

fellow-citizens, that he might have allowed Mr. Mantell the privilege of keeping this *Apteryx*. As to drainage, he doubted whether there was any prospect of Mr. Higginson's or any other scheme being adopted. There was a proposal for borrowing now before the city, but no scheme of drainage. He remarked that the smells in the city were certainly very bad.

The motion for a vote of thanks was carried unanimously.

The President thanked members for the vote just passed. Replying to Mr. Maskell, he said he had purposely abstained from mentioning any details of municipal politics, fearing that he might introduce discussion in the wrong place. It would be for Mr. Maskell, as a ratepayer, to examine the proposals put before the public, and see whether they were in accord with his views as a scientific man. If not, he must organize, and see that a proper scheme was brought forward.

A number of photographs exhibited by Mr. McKay, showing the effect of the earthquake of the 1st September last in the Amuri district, were explained by Sir James Hector.

Papers.—1. "On the Occurrence of *Mitrasacme montana*, var. *helmsii*," by T. Kirk, F.L.S. (*Transactions*, p. 445.)

2. "Description of a New Species of *Chenopodium*—*C. buchanani*," by T. Kirk, F.L.S. (*Transactions*, p. 446.)

Second Meeting: *10th July, 1889.*

A. de B. Brandon, President, in the chair.

New Members.—T. Buckridge and E. Maxwell.

Papers.—1. "On an Entomological Tour on the Table-land of Mount Arthur," by G. V. Hudson, F.E.S. (*Transactions*, p. 179.)

A collection of the insects taken by the author, arranged according to the elevation at which they occurred, was shown, attention being directed to the gradual darkening in the coloration of the specimens with the increase of altitude.

Sir James Hector considered that Mr. Hudson had broken new ground, and shown how interesting is the study of the natural history of well-selected areas. The Salisbury table-land was peculiarly interesting, being one of the few surviving remnants of the great plateau out of which the New Zealand mountains had been sculptured during the more recent Tertiary period. The existing fauna and flora now found in the valleys and on the mountain-slopes must have descended from the ancient forms that now inhabited the plateau. On a former occasion the Society had before them in that room the collection made by Mr. McKay of the moa-remains found on the surface of the same plateau-remnant, which included evidence of the nature of the food and mode of nidification of these extinct birds. In 1863 the speaker examined another such remnant of the ancient land-surface, which he named Pigeon Hill, inland from Jackson's Bay, and there found tracks which must have been beaten down through the almost impenetrable scrub-growth by heavy-bodied birds like the moa, and also excavations, which had evidently been resting-places. Small birds like kiwi, kakapo, and wood-hen, by the constant use of these tracks had kept them open, though they

never could have made them in the first instance; and their great antiquity was proved by the manner in which they led up to both sides of great rents that had shattered the mountain-plateau, arising from that constant denudation of its flanks which was still in progress. The accurate study of such areas would afford a splendid holiday outing for young New Zealand naturalists. With respect to this particular locality, a good beginning had been made by Mr. McKay in its geology, Mr. Cheeseman in its botany; and now Mr. Hudson had in this paper shown that its insect-life was full of food for study. The mystery referred to of the blue-bottle fly occurring at high altitudes had yet to be solved; the speaker had seen them issuing in thousands from a crevasse in a glacier at 8,000ft. altitude.

Mr. McKay said that on the east edge of the table-land there was a tract of country honeycombed with caves, which should afford a large field to those in search of such forms as had been described by Mr. Hudson; but care would be required in venturing into the deeper recesses of this cavernous formation, since, if once the way were lost, escape would be almost impossible.

Mr. Park had seen the flesh-fly in great numbers at altitudes of 5,000ft. to 6,000ft.

Mr. Hudson, in reply, said that, with reference to the remarks made by Sir James Hector and others on the occurrence of the flesh-fly at great elevations, on glaciers, &c., he could only explain the circumstance as instances of insect-migrations. The blue-bottle fly, owing to its longevity (many individuals frequently living fully nine months in the imago state), would be especially able to undertake such journeys; and the fact of its doing so in past times might be inferred from the present universal distribution of the species of flesh-flies throughout New Zealand.

In reply to questions by Mr. Maskell as to the universal occurrence of dark-coloured insects at high altitudes and in the arctic regions, the author stated that all collections which had yet been made either on the tops of mountain-ranges or in the northern arctic or sub-arctic regions exhibited an invariable tendency to melanism; that it was considered to be the result of natural selection winnowing out the lighter forms, which were unable to stand in the struggle with the cold, and that those whose colouring enabled them to absorb the transient heat had alone survived. The white coloration of the warm-blooded vertebrates in the arctic regions was advantageous to them in enabling them to retain their internal heat, and the dark coloration to the *Insectæ* in enabling them to absorb the external heat.

2. "On certain Rare Minerals associated with the Tin-ore of Stewart Island," by William Skey, Analyst, Geological Survey. (*Transactions*, p. 415.)

3. "Notes on the Minerals from Stewart Island described by Mr. Skey," by Alexander McKay, F.G.S. (*Transactions*, p. 415.)

Sir James Hector said that tin had been found in small quantities in various parts of New Zealand, but Port Pegasus was quite a new though not an unexpected locality. He fully expected the same class of mineralized rocks to be found along the west side of Te Anau Lake. The variety of rare mineral specimens which had been collected by Mr. McKay, and analysed and identified by Mr. Skey, was very remarkable and especially promising. Giving a description of the range of the formation, by reference to a large geological map, Sir J. Hector pointed out that the mineral belt, which was characterized by highly-differentiated and

crystallized mineral species, was not to be confounded with the mineral belt of Hochstetter, often referred to in the Geological Reports, and which was characterized by the abundance of magnesian impregnations of the rock, and the occurrence of the ores of copper and chrome. This belt extended, but not continuously, from Nelson to the West Coast north of Milford Sound, whereas the tin-bearing rocks were in relation to granite-masses. He fully expected that the intersections of the system would yield valuable minerals. Discovery might be hastened by accident; and most probably the development of this form of the mineral wealth of the colony would be slow, and depend largely on the practical skill that is employed in the search. To find a white quartz in a blue slate was an easy matter, but to detect and trace mineral lodes required special training.

Mr. Marchant asked if the granite which occurred near the Owen and Wangapeka was the same as the tin-bearing granite of Stewart Island.

Sir James Hector, in reply, said that there were several distinct forms of granite. He did not consider that the granite east of Mount Owen was the same as that north of Reefton, where tin had been found: it was probably of much later date. The Separation Point granite was again different.

4. "On the Occurrence of Fluor-spar at the Bâton Goldfields," by J. Park, F.G.S.

Abstract.

In this paper the author describes a large deposit of fluor-spar recently discovered at the Bâton. Mr. A. Thomson, who discovered the mineral, took it for scheelite; but Mr. Skey proved it to be fluate of lime. The main outcrop of this interesting mineral is situated on the north face of Thomson's Hill, about half a mile from the saddle on the road from the Bâton to the Wangapeka. It occurs close to the point of contact between the crystalline limestone and granite, and measures from 30ft. to 35ft. in width, and from 50ft. to 60ft. in length, forming a rocky spur running parallel with the outcrop of the limestone and associated mica-schist and hornblende-gneiss. Following up a small stream falling into McRae's Creek, a branch of the Wangapeka, the fluor-spar can be traced by loose blocks on the surface a further distance of 20 chains. It is also abundant at the limestone caves near the source of this stream, being there associated with masses of barytes, hæmatite, and quartz-crystals. The main mass of the fluorite is granular, but it also occurs crystalline. Its colour is generally white and pale-green. This is the first discovery of this mineral in New Zealand; but, apart from the scientific interest attached to this, its occurrence has an important bearing upon the probable mineral resources of this district. Fluor-spar is constantly associated with lead and tin in all parts of Europe and America, and in the north of England it forms the gangue of the lead-veins intersecting the carboniferous strata. During the past two years a number of small veins of argentiferous galena have been found at the Owen and Wangapeka goldfields, and, judging from the presence of the fluorite, Mr. Park considers there is a strong probability that the veins found at the Bâton would be of a workable and permanent character, and for this reason he urges that the line of outcrop, the limestone caves, and, in fact, the whole of Thomson's Hill, should be thoroughly prospected for ore-deposits. At the same time, samples of all the minerals associated with the fluorite should be tested for lead, silver, and tin, and other precious minerals usually accompanying that mineral. Fluor-spar is a valuable flux for the reduction of refractory ores, and has been used for this purpose from the earliest times. It is also used for the manufacture of hydrofluoric acid, and as a glaze for pottery.

Sir James Hector considered the presence of fluate of lime a valuable indication that the agencies which had produced deposits of metallic ores had been in operation in the locality. Everything was tending to prove the correctness of the surmise he had frequently ventured, that the north-west district of Nelson would prove one of the richest mineral districts in New Zealand.

THIRD MEETING: *31st July, 1889.*

Mr. A. de B. Brandon, President, in the chair.

New Member.—S. Percy Smith, F.R.G.S.

Papers.—1. "On the Soaring of the Hawk—A possible Reason for Notched Wing-feathers," by T. W. Kirk, F.R.M.S. (*Transactions*, p. 325.)

Sir J. Hector said he considered Mr. Kirk's observations to be of great interest. The question of how the soaring flight of birds was mechanically maintained had long been a subject of discussion, and there were several interesting papers in the "Transactions of the New Zealand Institute" dealing with it. He had always held that the investigation should be founded on the anatomy of the birds. Many years ago, with Sir W. Buller, he had made dissections of the muscular attachments of the wing of the albatros, and at the time thought he had found evidence of the existence of tendinous expansions from the brachial muscles that could exercise a rotating influence on the quill-feathers, after the elbow- and wrist-joints were locked in full extension. The extended arm of the wing would then act as a sustaining parachute, while a slight "feathering" movement of the primaries, acting with the leverage at a distance from the centre of gravity of the bird, would exercise a great influence in controlling its direction of flight. Specimens of the albatros preserved in spirit had been sent Home, and submitted by Sir W. Buller to competent authorities, however, and this view had not been sustained. So far as he was aware, the mechanical effect of the interlocking of the primaries, rendered possible by their peculiar emarginations, as described by Mr. Kirk's paper, was certainly a novelty.

The Hon. R. Pharazyn called attention to a series of pictures in the *Illustrated London News*, taken from instantaneous photographs, showing the rotary motion of the wing-feathers of birds in flight. He stated that the motion varied in different parts of the wing, and he believed it quite possible that in some species the peculiar motion mentioned by the author did take place.

Mr. Kirk, in reply, said he did not enter upon the question of the supposed rotary motion of the wing-coverts at all. And the amount of rotary motion required in the primaries, supposing his idea to be correct, was very small—merely sufficient to allow the feathers to lock in the manner indicated. He was aware that the structure of the terminal joint would seem to preclude the possibility of a rotary motion of the primaries; but he believed that careful observations in the field and laboratory, aided by experiments, would yet prove that it was possible for the bird to alter the position of these feathers at will.

2. Further Evidence *re* the Korotangi, or Stone Bird. (*Transactions*, p. 499.)

Mr. Tregear said that he had no paper to read on the subject, but that he had received some documents bearing on the question, and would make some remarks thereon. He would first recall the main points of

the case to the attention of the Society. Some years ago, having noticed in the Wellington Museum the cast of a stone bird called the Korotangi which was labelled as purporting to have been brought by the Maoris from Hawaiki, he had induced the owner of the original bird to write a paper on the subject. The owner, Major Wilson, J.P., of Waikato, had intrusted the reading of the paper to him (Mr. Tregear), and he had read it at a meeting of the Society two years ago.* In this paper Major Wilson had repeated the description given by Dr. von Haast previously; had written out the Maori song supposed to refer to the Korotangi (with the translations, by the Ven. Archdeacon Maunsell and Mr. C. O. Davis); and had stated that very distinguished natives, including Tawhiao, Rewi Maniapoto, and Te Ngakau, had recognized the bird as a genuine and long-lost Maori treasure. After the reading of the paper a letter was received from Major Gudgeon, enclosing another letter from Lieut.-Colonel McDonnell, in which it was stated that the bird was a fraud perpetrated by Mr. Albert Walker upon Major Drummond Hay, who considered himself an expert in Maori curiosities, and by Major Hay had been sold to Major Wilson for £5. In the face of this doubt, at Sir James Hector's suggestion Mr. Tregear had withdrawn the paper until he could communicate with Major Wilson as to the truth of the statement. Major Wilson had, upon this, forwarded the documents which he (Mr. Tregear) now laid upon the table, being telegrams, receipts, &c., proving that the negotiation had been conducted solely between Major Wilson and Walker (as owner of the bird, for the natives, Walker's wife being a Maori woman of rank); that Hay had no part whatever in the transaction; and that £50 (not £5) had been paid for the bird, thus proving the entire *bona fides* of Major Wilson in the matter, he stating that had the price asked been £500 instead of £50 he would have paid it for so unique a relic, attested, as he believed, by the best native evidence procurable. Mr. Tregear added that he had no partisanship in the matter further than that he desired to affirm in the fullest manner the good faith of Major Wilson, who had, in response to Mr. Tregear's oft-repeated request, told the Society the whole truth he could discover as to the identity of this carving with the Korotangi mentioned in Maori song. His earnest desire was to ascertain the truth, and to ask the Society as to their opinion respecting the conflict of evidence, and the weight to be assigned to the statements made on the different sides.

Major Gudgeon said he quite accepted that Major Wilson believed the Korotangi bird to be a genuine Maori relic of the past, and that the Maoris had recognized it as such. Moreover, the documentary evidence produced by that gentleman showed that Mr. Walker had not spoken quite truthfully when, in conversation with Colonel McDonnell, he described the finding of the bird and the manner in which he had sold it. At the same time, he did not consider the evidence in favour of the antiquity of this carved bird satisfactory. As for the *waiatas*, who could say that they really did apply to this particular bird? They might apply to a Korotangi; but was this bird the Korotangi? If this bird was genuine, and really was brought from Hawaiki, then it would have been regarded almost as a deity by the tribe to whom it belonged. It would have been placed in charge of a great *tohunga* in trust for the tribe, and would have been carefully hidden by the custodian; and if this man happened to have died suddenly from any cause no doubt the said *atua* would have been lost to the tribe; but in such case all the circumstances of the loss, even to the name of the man who lost it, would have been carefully preserved by tradition, in order that, if at any time the treasured relic should be found, the rightful owners might thereby be enabled to reclaim their own. (Here instances were given as to how valuable *meres*, &c., had

* "Transactions," vol. xx. p. 450.

been lost, but in every case the circumstances of the loss had been preserved and handed down.) If this bird was genuine, and all that it was alleged to be, then there should be no difficulty in ascertaining how or in what manner it had been lost, who was the original owner, and who the man was that died without disclosing the hiding-place of this *rara avis.* He would not say that he thought all Maori traditions reliable, especially where they related to affairs of the other world or matters connected with far Hawaiki; but when the traditions related to the acts or omissions of men he thought they might be accepted not only as reliable but without question—provided always that they did not appear in the form of a *waiata:* in such case he would be suspicious; for who could translate it satisfactorily? Probably not three men in New Zealand; for to do so one must know the exact circumstances under which it was made.

Mr. Coleman Phillips said that if the bird had really been brought over in the Tainui canoe, as alleged, similar carvings should be found in some of the South Sea islands, whence the Tainui came; but he was not aware of any. He would look the matter up upon his return home; but he was certainly unaware of any carvings in the islands similar to this one. The bird did not look to him at all like a native carving; there was an appearance about it of some hand used to sculpture in our own way. Not that the South Sea islands afforded no traces of stone-workers. There were the stone images of Easter Island, the monoliths and trinoliths of Tonga, the cyclopean remains of Strong's Island, and certain remains of aqueducts in New Caledonia.

Sir James Hector.—And the chalk figures from New Ireland.

Mr. Phillips said, Yes; but he had often thought that the New Ireland Islanders were taught that kind of carving by the Spaniards, it being now some four centuries since the Spaniards first landed there. However, he would look up the question of modes of carving. With regard to Mr. Albert Walker and Major Wilson, he knew them both. It was now some eleven years since he met Mr. Walker, whom he then considered an honourable man. Major Wilson was a thoroughly honourable man. Mr. Walker might have treated this finding of the Korotangi as a joke, but not as a fraud. If the members of this Society thought differently, he would write to Mr. Walker himself, and ask him to explain the matter if he would. The history attached to the bird might be a fraud; and Mr. Walker might have been personally deceived. He remembered reading a short paper some years ago in that room upon a curious method of arrow-propulsion that he had observed amongst the Maoris.* He was told by Mr. Colenso and others that the Maoris had been taught this custom by some whalers.

Mr. Tregear.—No.

Major Gudgeon.—No.

Mr. Phillips.—Indeed! Then he was glad to find that his paper was correct. He would write to Mr. Walker about this bird.

Mr. Maskell said that in one way this was rather an important question, as affecting the honour of the societies affiliated to the New Zealand Institute. In 1880 Sir J. von Haast, accepting the story of the finding of this bird in the North Island, and of its antiquity, laid a model of it before the Philosophical Institute of Canterbury; and in vol. xiv. of the "Transactions" might be found a short paper by him, in which he attributed the carving to Japanese artists.† Since that time the stone bird had been accepted as a genuine relic, and models of it appeared in all the museums of the colony. Now, if the whole thing was a fraud, all of our societies had been, practically, taken in by a modern edition of "Bil Stumps his mark;" and it did seem that, as a matter of honour,

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* "Transactions," vol. x., p. 97.
† "Transactions," vol. xiv., p. 104.

this question should be cleared up. For this purpose he ventured to suggest that Mr. Walker should be communicated with, and asked to make a definite statement on the matter. Mr. Tregear maintained the genuineness of the bird; Colonel McDonnell declared that a direct fraud had been perpetrated. One or other of these statements was true; but if the latter was true, then all the scientific societies of New Zealand had been most unworthily deceived, and their honour was involved in the matter. But it seemed to him, also, that a further and much more important question was raised in connection with this bird. The asseveration of the Maoris, as adopted by Mr. Tregear, was that the bird was brought by their ancestors from that mythical place Hawaiki, and that it was an object of intense veneration amongst them. For his own part, he attached no value to Maori legends and traditions beyond the date, say, of a man's grandfather. Within such a period a Maori would probably know many actual facts. The memory of savages did not, as a rule, go much further back; and as to occurrences of earlier date, the speaker inclined to the belief that a Maori would manufacture legends by scores to order—not, perhaps, about actual deeds of warfare or domestic life, but certainly as to relics such as this bird, or anything in connection with gods and heroes; much more especially if "Hawaiki" came into discussion. But, leaving these old women's fables aside, it seemed not impossible that the bird might be accounted for in another way. From the date when Vasco di Gama rounded the Cape of Good Hope to the arrival of Captain Cook in New Zealand somewhere near 350 years elapsed. During that period the eastern and southern seas were traversed by hundreds of ships—Portuguese, French, Spanish, Dutch, and English—manned by hardy navigators, who thought nothing at all of braving the terrors of unknown seas. As regarded the Portuguese and the Dutch, the speaker had reason to believe that the captains of their early ships were not allowed, except in special cases like Tasman's, to publish records of their voyages. These records were sent in only to their respective Governments, and he felt convinced that in the archives of Lisbon and Amsterdam there might be found numbers of such unpublished "ships' logs." In the 350 years just mentioned there was room for any number of ships to have touched at New Zealand, and from any one of these the stone bird might have been stolen by the Maoris, and afterwards made the subject of songs, of legends, and all sorts of rubbish. On these considerations he ventured to move, "That the Council of the Society be requested to open communications with the Governments of Portugal and Holland, with a view of ascertaining whether there are to be found in the archives of those countries any records of ships which may have touched at New Zealand prior to the visit of Captain Cook, besides those of the expedition of Tasman."

Mr. S. Percy Smith said he considered the question of the authenticity of the Korotangi a matter of great importance in relation to Maori history, and hoped the Council would endeavour to clear up the doubts that existed as to the real facts of the finding of it. No doubt the means still existed for ascertaining these facts, and if inquiry were directed to the proper source the matter would be cleared up. It had been mentioned in Major Wilson's paper that several well-known chiefs had recognized the bird as one of their ancient *atuas*; amongst them were Rewi Maniapoto, Tawhiao, and Te Ngakau. The two former were still living, though the latter was dead; and application to them, or to Wahanui or Taonui, all descendants of those who came over in the Tainui canoe, would soon elicit the fact as to whether the Korotangi was known to them by tradition. There could be no doubt, as pointed out by Major Gudgeon, that, if the Korotangi was a *bonâ fide* Maori relic of ancient times, the tribe to whom it formerly belonged would have exact traditions of it. Rewi Maniapoto, though now a very old man, was well acquainted with the history of his tribe, and could certainly throw light on this subject if

the matter were put to him in the proper way. With regard to the doubts which had been thrown on the value of Maori traditions, a study of the language and history of the race extending over a period of thirty years had convinced the speaker that, with some allowances, they were very reliable, a fact which was proved by the slight divergences in the same traditions as gathered from tribes inhabiting the extreme ends of the islands, and which had been separated from one another for many generations without any communication. He thought that it required an intimate knowledge of the language and people to be able to decide on this question. Korotangi was one of the three peculiar articles in the possession of the Maoris which, if their origin could be cleared up, would also throw a flood of light on Maori history. The other two were the Tamil bell,* in Mr. Colenso's possession, and the stone "kumara god," in the Auckland Art Gallery. He hoped the Council would take steps to clear up the doubts which at present seemed to exist with regard to this matter before it was too late.

Mr. Travers said, if the bird was meant to represent *Prion vittatus*, as had been suggested, then the image must have been made south of the line, and not lower in latitude than about 40° south, because that bird was very rarely found north of that parallel, and therefore the carver of the bird could not have seen it if he lived either north of the line or within tropical areas. Mr. Walker was not likely to admit anything now, if he was guilty of misrepresentation in the first instance. He thought, with Major Gudgeon, that the proper course was to make inquiries of the natives and others as to how the image was lost sight of, and so forth. Major Gudgeon would no doubt, assist in this. It was easy to make Maori stories fit in with what it was desired to prove, especially in regard to old traditions.

The President said that if the Korotangi was genuine there should be no difficulty in tracing the persons who found it. Referring to Major Gudgeon's remarks on the translation of *waiatas*, Mr. Brandon called attention to the two translations of the same song, by Mr. C. O. Davis and Archdeacon Maunsell respectively, which were in Major Wilson's paper.

Sir J. Hector thought this discussion proved that the Governors had acted prudently in deferring the publication of the Korotangi paper until reliable information could be obtained concerning it.

Mr. Tregear, in reply, said that he considered Mr. Maskell's suggestion, in regard to communications being opened with the Governments of Holland and Portugal, was a very valuable one. Now that the jealousy had passed away which a few centuries ago was rife concerning discoveries and explorations of new countries, it was very possible that information of a valuable character in a geographical sense might be brought to light if access could be obtained to national archives. He did not think much good would result from the other inquiries proposed. Mr. Albert Walker was, he believed, roaming somewhere in the South Seas, and, even if applied to, would be scarcely likely to acknowledge having perpetrated a fraud. Rewi had already expressed his belief in the relic; and Mrs. Wilson (whose death had been imputed to witchcraft from the possession of the bird) was Rewi's niece. He disagreed with Mr. Maskell (as he always did on this particular point) as to the worth of the native traditions, and would go further than Mr. Percy Smith in his evidence as to the legends being common from the northernmost to the southernmost points of New Zealand, by saying that the Maori traditions were known from the most eastern island of Polynesia to the most western, although language, customs, worship, &c., had infinitely changed. Thus, any tradition in which the Korotangi was mentioned

* "Transactions," vol. iv., p. 40, pl. ii*a*.

was to him a valuable piece of testimony. The evidence given by natural science on the subject appeared only to land them on the horns of a dilemma. One geologist stated that the stone of which the bird was composed was the pipe-stone of the North American Indian; another asserted that the carving was Japanese; while the ornithologist pointed out that the bird (whose species was unmistakable) was never found north of the equator—not even far north in New Zealand. He did not desire that the paper should yet be printed, but that the question should be left open; and he would endeavour to obtain sworn evidence from those who were present at the finding of the carving, if it should turn out that Mr. Walker's assertion as to his having purchased it on board some New Zealand coaster should be proved to be incorrect.

The resolution proposed by Mr. Maskell was carried.

3. Sir James Hector read an account by Mr. Skeet of the appearance, observed from the. coast at White Rock, of what appeared to be rocks far out at sea. A sketch was shown, giving the position of the supposed rocks.

Mr. Travers said that it was most probably a large log, with birds upon it. Such a sight had been observed once at Nelson, and had caused some excitement.

Exhibits.—Mr. Hudson exhibited a valuable collection of New Zealand *Micro-lepidoptera*, which had been described in recent papers on the subject published in the "Transactions."

Sir James Hector exhibited several drawings of fishes recently collected by Mr. Drew, of Wanganui, some of which were either rarely met with or were new additions to the fauna. Among the former was the red mullet, a valuable food-fish that was highly prized by the ancient Romans. It was first found in New Zealand by Captain Cook, and nearly a hundred years elapsed before another specimen was caught, and the speaker had only seen five or six altogether; yet it must be tolerably abundant. Among the specimens new to New Zealand waters were the following: *Chilodactylus zonatus*, of the Japan seas, and *Duymæria* sp. (*D. flagelliferæ*, Japan). Another fish had also been received from Captain Fairchild, which was probably the species of wrasse or *Labrus* described by Dr. Solander, of Cook's expedition, and which had not since been identified.

Fourth Meeting: *28th August, 1889.*

Charles Hulke, F.C.S., Vice-president, in the chair.

New Members.—J. B. Harcourt and F. Wallace Mackenzie, M.B.Ed.

Papers.—1. "On the Chinese Settlement in New Zealand and Australia," by Coleman Phillips.

Abstract.

Mr. Phillips, in his paper, desired to obtain the opinion of members of the Society upon Chinese immigration, as a philosophical question.

If we brought here the best plants, the best animals, the best mechanical inventions, our duty was to people these islands with the best men and women. The best races for colonization in temperate zones were—(1) The Scandinavian; (2) the English, Scotch, and North-east of Ireland people; (3) the German: in tropical zones, the Asiatic and negro tribes. Unless precautionary measures were taken, one Asiatic people—the Chinese—would very likely take possession of Northern Australia, which the author deemed inadvisable. He thought that the Australasian Colonies should be divided into three zones of settlement: the first, or temperate zone, to comprise New Zealand, Tasmania, and the southern coast of the Australian Continent; this zone to be reserved for Scandinavian, English, Irish, Scotch, German, and other such settlement: only 1 per cent. of Chinese to be allowed to reside therein. The second zone to be the more central parts of the Australian Continent, wherein 3 per cent. of Chinese should be allowed to reside. The third zone to be Northern Australia, wherein the settlement should be as follows:—

Anglo-Saxon	10	per cent.
German	10	"
Scandinavian	10	"
Italian	10	"
Chinese	10	"
East Indian	10	"
Malay	10	"
Japanese	10	"
Negroes	10	"
Arabs	5	"
Various other nationalities	5	"
Total	100	

To absolutely prohibit Chinese settlement in any part of the Australasian Colonies Mr. Phillips thought barbarous and most inadvisable. He would rather control the immigration in the above-named proportions by the issue of residential licenses, or passports, in an exactly similar manner to German or French passports *inter se*, our consuls in China to issue these licenses to respectable Chinese only, and not to the convict class. We had prevented English convicts from coming here, and we were trying to prevent French convicts. Surely we could stop Chinese-convict settlement. In New Zealand there was nearly 1 per cent. of Chinese population already. Residential licenses should be issued to each of these persons forthwith. These could be viséd for any place in the colony where Chinese settlement was not too numerous. No Chinese quarter should be allowed in any city of Australasia upon any account whatever; the police to see that this regulation was especially complied with. Mr. Phillips was also of opinion that European immigration should be encouraged in large numbers, so as to occupy the temperate zones of Australasia before the Chinese took up their residence. The United States of America met the threatened Chinese invasion in the best way when it peopled its territory with fifty million Europeans. The future sovereignty of the Australian Continent was involved in this question, and Australasia should be peopled as rapidly as possible from the Anglo-Saxon stock. In his paper the author gave the Chinese every credit for the virtues they possessed, whilst at the same time he exposed their vices, which he said had to be provided against.

Sir James Hector thought that the political aspect of this important question was not suitable for discussion here; but it had also a wide bearing on ethnological science. As regarded the Chinese, taken as a whole, no section of the human race extended over a wider range of climatic conditions, and yet preserved what were to our eye constant national characteristics; nevertheless, there must be great differences in

character and habit, and consequently classes of Chinese might exist that would be dangerous among our community, while others might be unobjectionable, and even desirable. There was, however, a wide gap between Chinese and European races; and why should the colonies, which had been secured with so much enterprise as a relief for the overcrowding of our own parent-country, be voluntarily surrendered to an outside race? The speaker also expressed himself strongly against the establishment in our towns of special Chinese quarters.

Mr. Hulke said that Mr. Phillips deserved great credit for having had the courage to tackle the Chinese question; but he did not think the idea could be carried out. We could not legally or morally prevent their coming. We ought, however, to make laws to protect us from any evil that might arise from their presence. We could put a material check upon them by enacting that no foreigner might keep a retail shop—any one wishing to do so must thus become naturalized; and this was very repugnant to the feelings of a Chinaman, for when once naturalized—his pig-tail cut off—he would lose caste, and could not well return to China. As gardeners they were a necessity.

Mr. Phillips, in reply to Sir James Hector, said that the control of the immigration would be quite easy. A certain amount of fraud would be committed in consequence of the resemblance of the Chinese to each other; but a percentage might be allowed for fraud. A certain amount of evil existed under every law. There were, luckily, only certain treaty-ports from which the Chinese could emigrate, and our consuls were there. When the number of residential licenses for each colony had been granted, no more would be issued. Each Chinaman with us then must always possess his license. He might pass it on to a friend, but the punishment for such an offence (being without a license) would be deportation to China. The Chinese authorities would see the wisdom of this course, as they did not allow us to travel much beyond the treaty-ports. It was necessary for us to treat China courteously. She was our nearest neighbour, and a powerful one too. Some future Chinese Tamerlane, issuing out of Northern Australia and sweeping down the Queensland coast, might lay every city in ashes. It was more advisable to cultivate feelings of friendship with so powerful a neighbour than feelings of enmity. Hostile feelings easily take root in the birth of young nations.—In reply to Mr. Hulke, Mr. Phillips said he did not think it right that we should insist upon the naturalization of the Chinese. If we insisted upon that, then China could insist upon British residents in China giving up their nationality and becoming Chinamen.

Exhibits.—1. A large series of the fossil plants of New Zealand, collected by the Geological Survey Department, was exhibited.

Sir James Hector stated that he had recently, through the kindnes of Mr. Forbes, at Christchurch, and Professor Parker, at Dunedin, had an opportunity of examining the type-collections which had been submitted to and described by Professor von Ettingshausen. He found that there had been a considerable admixture of localities; and that when these were rectified most of the discrepancies between the conclusions of the learned palæo-botanist and the views held by the Survey as to the geological classification would disappear. The Professor's work was now being translated from the original German, and would be laid before the Society with a full commentary at an early meeting.

2. Mr. McKay exhibited a curious growth of potato, containing seven distinct parts and joined in the centre, and weighing nearly 5lb. It was grown at Patea. He also showed a photograph of the specimen from different views.

Mr. Maskell did not suppose there was any particular advantage in having growths of this enormous size. He would prefer the ordinary size.

3. A gurnard, received from Mr. Hamilton, of Napier, was exhibited.

Sir James Hector said it was probably the true *Trigla vanessa* of Richardson, which has been confounded with another fish from Tasmania, figured in Professor McCoy's "Zoology of Victoria." There were three species of the gurnard already known in New Zealand, and this probably made a fourth.

Fifth Meeting: *2nd October, 1889.*

A. de B. Brandon, President, in the chair.

New Member.—Robert Heaton Rhodes.

Papers.—1. "On *Eristalis tenax* and *Musca vomitoria,* two Flies new to New Zealand," by G. V. Hudson, F.E.S. (*Transactions,* p. 187.)

Sir James Hector asked the author of the paper whether he could offer any explanation as to why the humble-bee had spread with such rapidity in the South, and not made its appearance in the North Island.

Mr. Travers said he had liberated the humble-bee in the neighbourhood of Masterton two years ago, and they must have increased, as he had seen them in his own garden in Wellington. He procured them for the purpose of fertilizing the red clover. The Acclimatization Society had not paid sufficient attention to this matter. With respect to *M. vomitoria,* it was looked upon with dread by the sheep-farmer in England, as it not only damaged the wool, but deposited its ova in the sheep, and caused great trouble; so that it was rather alarming to learn that this fly had appeared here.

Mr. Phillips had noticed that sheep had been attacked by flies in the way described by Mr. Travers, and the remedy used was kerosene.

Mr. McKay said that the sheep were attacked when the wool was moist, especially on warm wet spring mornings, and the fly did not confine its attack to one particular part, but attacked various parts. The introduction of *M. vomitoria* was a serious thing for the sheep-farmer.

Mr. Maskell said that attempts were made in the early days to introduce the humble-bee in Canterbury, but they were not a success. Five or six years ago, however, there was a fresh importation. The increase had been something wonderful; in fact, they had in the South become a nuisance, and the people complained that they deprived the ordinary bee of the means of making honey.

The Hon. R. Pharazyn said bees and flies were like rabbits—when first introduced they were not noticed, but after a time the increase was so enormous that it was difficult to keep them down.

Mr. Field said it was easy to drive away the humble-bee by growing the common elder, which they objected to. He was advised not to take them to Wanganui, as they spoilt the flowers.

Mr. Hudson, in reply, said that the probable reason why the humble-bee had not established itself in the North Island was owing to its being a social insect, thus rendering the introduction of an entire nest necessary for its establishment in any fresh locality.

2. "On Rabbit-disease in the South Wairarapa," by Coleman Phillips. (*Transactions*, p. 308.)

The President, in inviting discussion, remarked that he did not understand why the author should complain of it as selfish to make use of the rabbit-proof fence if it formed a protection against the pest. He would like also to know what Mr. Phillips meant by a "minimum-of-safety stage."

Mr. Travers said that the spread of the disease referred to could only be successful when a proper "host" was provided. He favoured the introduction of the natural enemy; but the ferret was not well understood—it was a delicate creature, and numbers died in the winter from cold. Proper breeding-establishments should be erected, and this would be better than importing the animals.

Sir James Hector said, as he had been referred to by the author of the paper, he ventured to express an opinion that the only effectual way of dealing with the rabbit-plague was by following Nature; but he had not much faith in some so-called natural enemies, unless it could be shown that they would be able to destroy by communicating disease. Many years ago he had called the attention of Government to the sudden and periodical disappearance of rabbits from the north-west territory of Canada, speaking from his own experience. Government had obtained ample evidence confirming this important fact, but up to the present time the nature of the disease had not been ascertained. It was evidently related in some way to the carnivorous animals that prey on the rabbits. His own recollection of the symptoms favoured the idea that it in some way resulted from the direct or indirect action ot Entozoa. He had therefore suggested that the bladder-worm and liver-fluke of the rabbit might be a modified form of the same disease. It was certainly not the same so far as its virulence went; but the question was, whether these bladder-worms might not under peculiar conditions become the carriers of microbes that set up a more active specific disease, either like chicken-cholera, or perhaps a putrid fever which becomes contagious. Anyhow, it was not enough merely to say what this disease was not. The great importance of the subject to these colonies required that the nature and cause of this disease should be found out; and unless good reason could be shown that it would endanger other forms of life, of which there was no evidence as yet, then let it be introduced; and, if it worked as the speaker had seen it do in Western Canada, the difficulty would be at an end. Perhaps it might be done by bringing some of the rabbits from the affected districts and turning them out here. It was obvious that any cause that would prevent the does from breeding was what must be aimed at. Speaking of the various natural enemies, Sir James said he had some years ago suggested that the black ferret of the American prairies should be introduced, as it was a fierce hunter, and, being a perfectly wild animal, would probably be more hardy than the English ferret.

Mr. Field said,—I have listened with great pleasure to Mr. Phillips's paper and Sir James Hector's remarks, because they seem to me to throw light on what has long been a great puzzle to myself and others—viz., the reason why rabbits will not thrive between the Tararua Range and New Plymouth, nor, apparently, from there northward. They have been repeatedly turned loose, but have never become troublesome, and generally have died out in a few years without apparent cause. I may mention the following cases within my own knowledge: I first saw rabbits running wild in New Zealand at Taranaki, in September, 1851. There were then a good many near the Grey Institution, and thence to Omata. I learned, in 1886, that they had been extinct there so long that only a few old settlers seemed to recollect them. I saw many rabbits a few weeks later between the Manawatu and Rangitikei Rivers, where they had been

turned out by Dr. Best, who had occupied a run there. There are still a few in that locality, near Carnarvon—about one to the hundred acres. A year or two ago they seemed to be increasing on the Oroua Downs run, and the manager employed men to destroy them, and killed off several hundreds. I next saw rabbits towards the end of 1851, about the head of the Wanganui Racecourse, and thence to Kai-iwi. There were large numbers of them, the country being sandy fern-hills, and flats of manuka scrub and toetoe. A few years later they disappeared, and there have been none there for at least twenty years. From 1852 to 1854 I was often along the coast between Wanganui and New Plymouth, and saw rabbits near almost every pa, the Maoris having liberated them. At Nukumaru, where at that time I have shot four or five couple in an afternoon, there are still a few, which sometimes increase for a year or two, and then die off again; and a local paper mentioned several years back that the Sheep Inspector had ridden into Hawera, much excited at having seen a rabbit by the roadside. This was in a place where in 1853 they might have been counted by hundreds. About 1855 rabbits were turned out at Goat Valley, near Wanganui, and spread rapidly. The soil was sandy loam, covered with fern, and with patches of scrubby bush at the heads of blind gullies, of which they took possession. Several years later a settler who lived two miles off went to England, and on his return brought out two Skye terriers. Soon afterwards the rabbits disappeared, and these dogs got the credit of having killed them all. They may have killed some close at home, but were not likely to do so several miles off. From 1860 to 1865 there were large numbers of rabbits along the coast-country between the Wanganui and Wangaehu Rivers, and the Wanganui lads used often to get a fair bag of them on a Saturday afternoon. When surveying there in 1880 I saw two rabbits in four days; and I do not think there are even so many now. About 1858 rabbits were turned loose between Turakina and Marton, and increased for a time; now, I learn that only an occasional one is seen. In all these cases the rabbits turned out were tame ones, and it was thought that perhaps they were too delicate to live wild. About 1855, however, the late Major Nixon returned from Nelson to Wanganui, and shortly afterwards he got some wild rabbits from Nelson, and turned them loose on his land opposite the town. The place seemed made for rabbits—pumice soil, with large areas covered with furze and high manuka scrub. By 1862 they had spread to a distance of two or three miles, and were in considerable numbers; but a year or two later they disappeared as if by magic, and I have not seen or heard of any there since. About 1865 the Wanganui Acclimatization Society took some trouble to get wild rabbits from Canterbury, and turned them out near my own house. The conditions—pumice soil overgrown with furze and manuka scrub—seemed to suit them exactly; and they increased so rapidly as to threaten to become a nuisance. I saw many in my paddock, and shot several in my garden. They held their ground for perhaps ten years, and then died out. The conditions are unchanged, yet I have not seen or heard of a rabbit thereabouts for certainly five years. About twelve years ago I went to Palmerston North, and found the people there rather excited at rabbits having appeared at Fitzherbert. They were supposed to have crossed the range from the Wairarapa side. Several years later I inquired about them, and learned that they were seen for a time and then disappeared. When in Auckland in 1886 I saw rabbits running loose in a friend's paddock, and on my remarking the fact my friend said that they did no harm in that part—that they had been repeatedly turned out, and always died off after a short time. It seems to me that it might be worth while to try and find out what kills the rabbits over so large a portion of this island, and endeavour to introduce it elsewhere. It would be far better than introducing ferrets and weasels, which will kill the poultry and game as well as the rabbits. But rabbits are not the only things that

die off in our part. Rats are a great pest; the bush swarms with them. Pigs, too, are fairly numerous, and form an important article of food to survey- and road-parties, bush-fellers, and others. Every few years, however, one sees dead rats and pigs lying about in considerable numbers; and the rest are scarcely able to crawl about, and fall away to skin and bone. In these seasons a wild pig fit to eat cannot be found. The rats seem to be first attacked. About November dead ones are seen lying about, and soon afterwards there are dead pigs also. I have thought the pigs perhaps get infected through eating the dead rats. The disease lasts all through the summer; but the animals which survive till April or May seem to recover. As I learned that the subject of rabbits was to be discussed to-night, I thought it might be well to mention what I have now said, as it may lead to inquiry, and so to some simple means being found of keeping down these animals.

Mr. C. Pharazyn admitted that the disease mentioned by Mr. Phillips carried off a certain number of rabbits; but said that by the aid of ferrets and other natural enemies he had got rid of the pest on his property. At one time a man could go out on the land and get eighty rabbits a day, but now it would be difficult to kill three per diem; and all this had been done at a cost of not more than £100. He firmly believed in the natural enemies, because a flesh-eating animal was required to destroy one which subsisted on grass and other green stuff. Millions of pounds were being lost through the rabbits, and yet Government took no effective means to eradicate the pest. He suggested that Government should place the matter of rabbit-extermination in the hands of some scientific men.

Mr. C. Hulke confirmed Mr. Field's statement regarding the disappearance of the rabbits from the district round about Wanganui.

Sir James Hector thought it was possible the wild native dogs might have had something to do with the disappearance of rabbits in the district mentioned by Messrs. Field and Hulke. European dogs, when ill, relieved themselves by eating grass and herbs; but it was possible the wild dogs did not do this, and that the diseases from which they suffered were caught by the rabbits, who died in consequence.

Mr. Field explained that the pure native dog had disappeared long ago. The wild dogs of the present day were animals which were a cross between the Maori and the European dog.

The Hon. R. Pharazyn pointed out that there had been a mysterious disappearance of rabbits from the Waitotara district. This had been attributed to wet seasons; but he was unable to say whether the wet weather had anything to do with the diminution of the pest.

Mr. W. H. Beetham, at the invitation of the Chairman (though not a member of the Society), made some remarks on the subject, and said he also favoured the introduction of the natural enemies, as he looked upon poisoning and trapping as much too costly. He attributed the great decrease of rabbits in the South Wairarapa to the introduction of ferrets, stoats, and weasels. The loss in the Wairarapa through the rabbit-pest was something enormous, the cost of poisoning on his station in six weeks amounting to £800. He was afraid that, unless effective means were taken to eradicate the plague, many property-owners would be ruined.

Mr. Coleman Phillips, in reply to the President, said that the expression used by him, "minimum-of-safety stage," meant that stage beyond which the rabbits could not be reduced. With regard to what had fallen from Mr. Travers respecting the delicacy of the ferret, he would say that the ferret had increased in the Wairarapa, notwithstanding its delicacy; but he would advise runholders to build little inexpensive earth homes, and cover them with scrub, in different parts of their runs, as a protection to ferrets, stoats, and weasels. In answer to Sir James Hector, Mr. Phillips asked him to qualify his statement "that he had not much faith

in the natural enemy." Nor did he believe in the plan advocated, to kill the does and let the bucks go. The does could not be killed upon the Crown lands. In reply to Mr. Field, he thought the results of that observer's experience on the West Coast worthy of careful consideration. He believed that the dingo in Australia would be found a most useful animal to spread the bladder-worm in that great continent. In reply to Mr. W. H. Beetham, Mr. Phillips said that the rabbit-pest was pretty well conquered upon the runs near the Ruamahanga before Mr. Riddiford's stoats and weasels were liberated at all. In fact, it was conquered upon the Dry River Run without a stoat or a weasel ever coming there. But the steps taken in the conquest were carefully recorded and were fairly well known. When other localities cared to adopt them, they could also conquer their swarms. But fencing must not be relied upon, and trapping should be absolutely prohibited. No good could possibly be done until that was stopped. Bad spots could be properly cleaned out, not by trapping or fumigating, but by following the old practice of using tame ferrets and nets. There was nothing new to be learned about this rabbit question. The mistake was when the Royal Commission in Sydney sought for something new. The bladder-worm disease was as old as the hills, and well known for centuries in England. It did not sweep off the rabbits, but it stopped their breeding up again. He never claimed that it swept off its millions.

3. "Further Notes on *Coccididæ*, with Descriptions of New Species from Australia, Fiji, and New Zealand," by W. M. Maskell, F.R.M.S. (*Transactions*, p. 133.)

4. "On some Species of *Psyllidæ* in New Zealand," by W. M. Maskell. (*Transactions*, p. 157.)

5. "On some *Aleurodidæ* from New Zealand and Fiji," by W. M. Maskell. (*Transactions*, p. 170.)

Sixth Meeting: *4th December, 1889.*

A. de B. Brandon, President, in the chair.

New Members.—T. H. Fraser and Archibald D. Cooper.

It was announced that Mr. A. de B. Brandon, who had been nominated by the Society, had been elected a Governor of the New Zealand Institute for the ensuing year.

Papers.—1. "Remarks on Pathogenic Microbes, and the Means of preventing Diseases originating in their Introduction into the System," by W. T. L. Travers, F.L.S. (*Transactions*, p. 55.)

Sir James Hector praised the paper as an attempt to popularize the recent advances in this important question. Hitherto such subjects had been discussed too much as matters of special science by only a few; but the time had come when it was necessary to dispel the prevailing notions on infectious diseases, as they were little better than superstitions. This could only be done by the diffusion of accurate views derived from experimental science. He had within the last few weeks heard an excellent lecture delivered by Dr. de Zouche in Dunedin, which gave the fullest and latest information;* and had also read the discus-

* *Vide* Art. III., p. 31, *supra*.

sions before the Biological Congresses held this year in Paris and Glasgow, which he recommended to members as giving the latest views, which represent that microbes are not utterly obnoxious. They are, in fact, our best friends, being the natural scavengers that remove effete organic matter. The speaker then described the relation of the white corpuscles of the blood to microbes, and the poisonous products produced by the latter from the albumen compounds both in the live body (leucomaines) and in the dead carcass (ptomaines). He looked on man's industrial life as a continual struggle to prevent the microbes getting the upper hand. Correct knowledge of their life-history was especially important to this colony, where we had to depend so largely on organic products for our exports. Success in our methods of preparing produce for export—meat by freezing, and dairy products and beers by fermentation—all required thorough knowledge of such matters. Sanitary arrangements, suggested by the soundest scientific views, could be as easily adopted in this colony as any other, as they had not to compete with prejudice or vested interests. The question of overcoming the many pests that harass our industries must depend on our being able to spread epidemic disease, through the agency of microbes, but only in the direction we require. Thus the much-discussed rabbit-plague, there was no doubt, would only be overcome by bringing this branch of knowledge to bear on it; and the same with most insect blights. He thought Mr. Travers deserved the best thanks of the Society for the information he had given in his admirable paper.

Mr. Tregear expressed the opinion that some properly-authorized person should be appointed to inspect the meat-supply. If there was the least shadow of truth in the assertions frequently made, then there was considerable danger in the way matters were now being conducted.

Mr. Brandon said it was satisfactory to find that this important subject was becoming more understood. It was necessary, however, to go into the details most minutely, so as to acquire real knowledge. He understood that Sir James Hector did not believe there was any foundation for the recent scare on the subject of cancer.

Sir James Hector, in reply to Mr. Brandon and Mr. Tregear, said he quite agreed that there should be thorough inspection of all food-animals, and of dead meat, as in other countries, but he did not believe that the meat in this colony was any more diseased than elsewhere, and thought it was quite the reverse. It would be very injurious to the community if erroneous ideas on the subject were spread abroad; and loose or reckless writing on the subject must do real harm and create distrust of sound scientific teaching. The diseases of animals and plants used as food were not new things. The safeguard was thorough cooking of the food. Man had been defined as "a cooking animal." Probably it was this long-inherited instinct that had enabled the human race to conserve its growing store of experience, while other races of animals disappeared in succession, chiefly through epidemic disease.

Mr. Travers, in reply, said it was no wonder he could not give the latest information on the subject—he was not in possession of the latest works. His object was to place before the Society the facts of the case. The subject was a large one, and it was impossible to exhaust it. It was quite possible to prevent the spread of disease, and the public bodies should do their duty in the matter. He read extracts from a French paper calling attention to the killing of meat, and stating that 25 per cent. was rejected. He had not much faith in veterinary surgeons as being the proper persons to investigate this subject.

2. "On the Moriori," by E. Tregear, F.R.G.S. (*Transactions*, p. 75.)

The author read a letter from Mr. Shand, which described a basket canoe presented to the Colonial Museum; and also exhibited photographs of certain rock-carvings and figures carved on karaka-trees.

Sir James Hector said that the carvings on the karaka-trees mentioned by Mr. Tregear had been described by Mr. Travers in the "Transactions."* There was another canoe of somewhat similar construction also in the Museum, presented some years ago.

3. "On Adulterations in Drugs," by C. Hulke, F.C.S.

ABSTRACT.

The author stated that some three years ago he was annoyed when carrying out some researches at finding his work rendered useless and the results vitiated by the introduction of matter foreign to the materials he was acting upon, and also properly foreign to the reagents he was then using. He was too busy at that time to investigate the cause of the failure, and the circumstance was forgotten; but last winter it was again brought to his mind through his having to make a quantity of ammonium sulphide, and it was during its manufacture that he became aware of the cause of his former failure—viz., the impurity in the ammonia he had been using. He explained that his object in bringing the matter before the Society was to warn those who might seek to analyse their own ores to test the purity of their reagents, if possible, before using them, or they might possibly find things that were not in the specimen analysed. It was to the impurities of reagents, possibly and probably, that many of the discrepancies in the various analyses were due.

The President stated that this subject had frequently given rise to complications in questions regarding poisoning, in law-cases.

Mr. Maskell had found, in making preparations for the microscope, that the benzine sold by the druggists was very inferior, and no doubt adulterated. The only brand that could be relied on was Jackson's.

Exhibits.—During the evening Mr. Hulke exhibited a specimen of a strange spider that carried its young on its body without web or filament, but simply attached to the body, until they were able to run by themselves.

ANNUAL MEETING: *19th February, 1890.*

A. de B. Brandon, President, in the chair.

New Member.—H. M. Stowell.

1. The annual report and balance-sheet were read and adopted.

ABSTRACT.

The report reviewed the work of the year, mentioning that twenty-two papers had been read, and that interesting as well as valuable discussions had followed the various contributions. The microscopic section had pursued independent investigations into minute life, and had contributed an exhibit to the Dunedin Exhibition. Altogether, as far as scientific and useful work was concerned, the Society might fairly be said to have had a successful session. The report noted the formation of a Field Naturalists' Club, which should prove a powerful auxiliary to the Society. Twelve new members had joined the Society during the year.

* Vol. ix., p. 19, and pl. i.

Since the last annual meeting three prominent members had been removed by death—namely, Messrs. J. C. Crawford, J. Burne, and J. R. George—and this the Council recorded with regret. About eighty new works had been added to the library during the year, either by presentation or purchase. Referring to the donation to the New Zealand Institute by Mr. C. R. Carter of a valuable library of works on New Zealand, the Council considered the gift was a matter for congratulation to the Society in its capacity as an integral part of the Institute. Mr. Carter had for many years been a liberal benefactor to the Colonial Museum, and his present gift of books was only one of a series of public benefits. The Council did not think they would be stepping outside their sphere in recommending that the Society should pass a cordial vote of thanks to Mr. Carter for his generous donation. The library, with the addition of this collection, numbered some 4,000 volumes. Mr. A. de B. Brandon had been nominated as the Society's representative to the New Zealand Institute.

The balance-sheet showed that the year's receipts amounted to £161 17s. (including the balance from last year), and the expenditure was £158 13s. 6d.

Mr. W. M. Maskell moved, in accordance with the recommendation of the report, "That, as one of the societies affiliated to the New Zealand Institute, we record our full appreciation of the liberal donation by Mr. C. R. Carter to the Institute of a collection of books relating to New Zealand, and convey to him our cordial thanks for the same." The mover said he understood the collection was a unique one, containing the very fullest information regarding New Zealand from the earliest time to the present day. In making such a handsome gift Mr. Carter had conferred a great benefit upon the whole colony.

Sir James Hector, in seconding the motion, mentioned that the Governors of the New Zealand Institute had already taken steps to have Mr. Carter's gift placed for the convenience of the public, and access to it would be allowed to those who were studying or engaged in the compilation of other works. He considered Mr. Carter was deserving of the thanks of the community for his action.

Mr. Travers thought that as a preventive against destruction the works now in the library should be placed by the Governors in a suitable building, which could be erected at a cost of a few hundred pounds. The Government should be asked to assist in this matter.

The motion was carried.

Election of Office-bearers for 1890.—*President*—C. Hulke; *Vice-presidents*—A. McKay, E. Tregear; *Council*—W. T. L. Travers, H. P. Higginson, Hon. Robert Pharazyn, W. M. Maskell, Sir J. Hector, A. de B. Brandon, E. D. Bell; *Secretary and Treasurer*—R. B. Gore; *Auditor*—T. King.

Mr. Hulke, the newly-elected President, took the chair at this stage of the proceedings, and on the motion of Mr. Travers a vote of thanks was passed to the retiring President, who returned thanks for the compliment.

Mr. Hulke briefly addressed the members, approving of the formation of the Field Naturalists' Club, founded by Sir James Hector. He hoped to see a series of lectures upon such subjects as electricity, gold-assaying, &c., delivered during the year under the auspices of the Society, and said it was his intention to try and get gentlemen to undertake the task.

General Meeting.

C. Hulke, F.C.S., President, in the chair.

Papers.—1. "On Terrestrial Magnetism," by the Hon. Robert Hart, M.L.C. (*Transactions*, p. 129.)

The Hon. R. Pharazyn said that on hearing the paper read he had been impressed by the fact that it contained several ingenious theories which would require a great deal of careful examination before they could be accepted as sound. Mr. Hart's statement that "the earth in its diurnal revolution cuts the lines of physical force which hold the earth in its place," seemed a very metaphysical one. What are "the lines of physical force," and how could cutting them produce friction? Then, again, what evidence had we that the increase of sun-spots increased the force of gravity?

The Hon. R. Hart explained that what he meant was that sun-spots were caused by the removal of the cloudy envelope of the sun's photosphere, which thus permitted the action of gravity to be more intense. It was like the removal of a blanket from before a source of heat.

The Hon. R. Pharazyn.—Precisely; but that is what I deny to be possible. Gravity is a force which acts according to what is commonly stated as the law of inverse squares and direct mass. Now, there is not the slightest reason to suppose that this force can be affected, as light and heat may be, by any screen placed between the attracting bodies. Were this the case it would be an easy subject for mathematical calculation, and, considering the immense amount of attention that has been directed to the theory of gravitation, I do not see how it could have escaped notice. Then, too, if what causes sun-spots "intensifies the action of the sun's gravity," its effect would be apparent in astronomical observations and in the mathematical deductions based upon them. Nothing of the kind is ever heard of, however. I fancy Mr. Hart has confused certain magnetic forces with those of gravitation. Under certain conditions magnetic lines of force may be developed which, when cut by a moving body, offer what I think Professor Huxley has described as a sort of "sticky resistance," like the resistance caused by an imperfect fluid. There is, however, nothing analogous to this in gravitation. There are several other points in Mr. Hart's paper which I might touch upon, but I will not take up the time of the meeting any further. On the whole I am inclined to think, "as at present advised," that, ingenious and suggestive as Mr. Hart's paper is, a careful examination of it would show that the theories advanced in it are not in accordance with physical facts.

Sir J. Hector, although he must differ from the author, was pleased to hear a paper on this subject, especially as it brought up the question of magnetic observations. Nothing had been done in the matter since the first surveys. He believed the same instruments could be obtained again for use, so that the magnetic survey could be brought up to the present date. It would be a most important adjunct to the Geological Survey in detecting deep-seated lodes and faults, &c.

Mr. Tregear did not think dry air could produce sufficient friction to account for Mr. Hart's theory.

Mr. Travers said the magnitude of the sun must be taken into consideration in relation to its distance, and it was not surprising that it should exercise magnetic effects on our globe. There were many cases of intense electrical disturbances.

The President said it was difficult to give an opinion without studying the paper. Sun-spots did affect the earth as magnetical disturbances. There was a connection, but beyond that he was not prepared to go at present.

Mr. Hart said that a very slight addition to the sun's atmosphere would have a great influence on the earth.

2. "Note on the Wandering Albatros (*Diomedea exulans,*)" by Sir W. Buller, K.C.M.G., D.Sc., F.R.S. (*Transactions*, p. 340.)

Sir J. Hector said that Mr. Chapman had lately visited the islands referred to, and his views pointed to a different conclusion from that of Sir W. Buller. He hoped Mr. Chapman would place his notes on the subject before the society.

Mr. Travers mentioned that his son had also made observations on these birds on the expedition referred to by Sir J. Hector. The birds came to full plumage after four years, and began to breed before that time. He described how the gulls got the fish out of the bivalves by taking them to a height and letting them drop, when the shell broke and the fish was eaten.

Mr. Tregear had seen numbers of these birds at the Chathams. They had only white plumage, and were not able to fly.

3. "On some Maori Implements of Uncommon Design," by T. W. Kirk, F.R.M.S.

The specimens were procured from an old burial-ground on the east coast of the Wellington District. They are—

No. 1, Stone Axe.—A remarkably wide and flat weapon, 8¾in. long by 4in. in its greatest width—that is, just where the curve of the cutting-edge springs. From here to the top is a gradual curve, the narrow end which fits into the handle being somewhat rounded. It is ¾in. thick in the centre, whence it slopes in all directions, with a margin right round, quite as sharp as the usual cutting-edges. It is made of a dark-green clay-slate, and has been highly polished. A glance is sufficient to show that it is quite unlike an ordinary Maori *kapu*. There is, however, in the collection of Maori adzes in the Museum a specimen exhibiting a decided similarity to the Fiji weapons, being thick and rounded, tapering to a point at the head. The one before us is very like—indeed, almost identical with—one from Queensland presented to the Museum by Sir G. Bowen. This is, however, of undoubted South Sea origin. Indeed, the fact is well established that the natives of some parts of Australia obtain weapons from the Islanders. My weapon was found with portions of the skeleton of an adult Maori.

No. 2 is presumably a pestle for pounding fern-root. The total length is 10¼in.; the greatest diameter 2½in. at the middle, whence it tapers slightly and equally to both ends. The ends themselves are somewhat rounded, and are evidently meant to be used indiscriminately. The stone—apparently a hard sandstone—has been carefully dressed and smoothed, but not polished. It was dug out from near the root of a large karaka-tree, and is, so far as I know, unique as a New Zealand implement. An examination shows few or no points of similarity with the ordinary Maori fern-beater, whilst it reveals a wonderful likeness to the grain-pestles of some of the American Indians.

No. 3, a greenstone ear-pendant, in the form of an adze, 1⅝in. long by exactly ½in. in greatest width, is very flat, but pierced at the top to allow of a string to suspend it by. This was found buried with the skeleton of a young child; it was lying quite close to the skull. I have never seen an ear-ornament of this design before, though I believe necklaces of bones cut into similar shapes are known, but rare.

These few articles are exhibited this evening in the hope that those members of the Society who are skilled in Maori matters may be able to

give some explanation of the occurrence in this country of implements of an apparently foreign origin.

Sir James Hector said the specimens were very interesting, but, although somewhat different from some of the ordinary implements, he hardly thought they could be considered altogether rare. The Maoris were fond of cutting ornaments out of greenstone, and the reason of the small size of the adze was probably owing simply to the fact that the piece of stone happened to be no larger. It might have been a pure accident.

Mr. Percy Smith had seen stone axes very similar to No. 1, although perhaps not quite the same; neither did he think No. 2 altogether rare. There were a great variety of stone implements among the natives, and he did not think there was anything very uncommon in those before the meeting.

Mr. Tregear said he had a small adze almost exactly like No. 3, except that it had no hole in it. He thought it likely that the natives used these small adzes for fine carving; or, possibly, it may have been intended for a child's ornament.

4. "On the Assumed Hybridity between the Common Fowl and the Woodhen (*Ocydromus*)," by James Murie, M.D., LL.D., F.L.S. Communicated by Sir Walter Buller, K.C.M.G., F.R.S. (*Transactions,* p. 342.)

Mr. Tregear exhibited some skulls from the Chatham Islands.

AUCKLAND INSTITUTE.

First Meeting: *10th June, 1889.*

This meeting took the shape of a microscopical conversazione. Over fifty instruments were exhibited, and there was a large attendance of members and their friends.

Second Meeting: *8th July, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

New Members.—J. C. Blythe, Captain Colbeck, G. C. Munro, A. A. Partridge, Rev. R. Scott West.

Professor F. D. Brown gave a popular lecture on "Alloys," with experimental illustrations.

Third Meeting: *22nd July, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

New Members.—T. Humphries, Dr. Roberton, F. Grosch.

Papers.—1. "Notice of the Discovery of an Old Maori Wooden Comb on the Great Barrier Island," by H. Winkelmann.

Abstract.

In January, 1889, while exploring a cave on the Great Barrier Island, the author found an antique wooden comb, evidently of Maori origin; and he now exhibited it to the Institute. The cave is situated on the shore of the inner harbour, at Port Fitzroy, and is about 300yds. inland from the extremity of a small peninsula jutting into the harbour. It is about 100ft. above the level of the beach, and is surrounded by forest. Evidently it was used by the Maoris as a burial-place, for it contains many human bones in a good state of preservation. Mixed with the bones are the decayed remnants of some fibrous substance—perhaps flax matting. It was while searching among this *débris* that the comb was found. The author had been informed that previous visitors to the cave had brought away stone axes, fish-hooks, and a few greenstone ornaments; so that possibly a careful examination would bring to light other curiosities.

2. "Notes on Great Barrier Island," by S. Weetman, F.R.G.S. (*Transactions*, p. 79.)

3. "A Mysterious Therapeutic Agent," by E. A. Mackechnie. (*Transactions*, p. 119.)

FOURTH MEETING: *5th August, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

Mr. J. A. Pond, Colonial Analyst, gave a lecture on "New Zealand Fibres."

FIFTH MEETING: *19th August, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

New Member.—J. MacLachlan.

Papers.—1. "Notes on a Collection of *Pselaphidæ* from the Neighbourhood of Clevedon, Southern Wairoa," by Captain T. Broun. (*Transactions*, p. 230.)

2. "Notice of the Discovery of *Asplenium japonicum* in New Zealand," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 448.)

3. Mr. T. Humphries, Commissioner of Crown Lands, gave an account of the lately-discovered limestone caves at Waitomo, near Otorohanga, illustrated with lime-light transparencies prepared from photographs taken by himself and Mr. Hanna.

SIXTH MEETING: *2nd September, 1889.*

Professor F. D. Brown in the chair.

Professor A. P. Thomas gave a lecture on "The Story of the Waikato River."

The physical features and geological history of the Waikato Valley were fully described. During the course of the lecture numerous lime-light transparencies were exhibited.

SEVENTH MEETING: *16th September, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

New Members.—Dr. Girdler, J. Park, F.G.S., W. Wildman.

Mr. E. A. Mackechnie gave a lecture on the life and times of Hartley Coleridge, illustrated with views of the English Lake District.

EIGHTH MEETING: *30th September, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

Mr. T. F. Cheeseman, F.L.S., delivered a lecture on "Weather Forecasts and Storm-warnings."

The lecturer gave a description of the modern methods of predicting the weather, and the success that had been achieved in many countries, particularly the United States of America; and it was shown how far these methods were applicable to New Zealand.

Ninth Meeting: *14th October, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

Papers.—1. "Notes on some Relics of Cannibalism," by H. D. M. Haszard. (*Transactions*, p. 104.)

2. "On the Conformable Relations of the Different Members of the Waitemata Series," by James Park, F.G.S. (*Transactions*, p. 391.)

3. "Description of a New Species of *Argiope* from Fiji," by A. T. Urquhart. (*Transactions*, p. 234.)

4. "Descriptions of New Species of *Araneidæ*," by A. T. Urquhart. (*Transactions*, p. 238.)

5. "Tongarewa, or Penrhyn Island, and its People," by S. Percy Smith, F.R.G.S. (*Transactions*, p. 85.)

Tenth Meeting: *28th October, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

Dr. T. G. Davy gave a lecture on "Animal Heat."

Eleventh Meeting: *11th November, 1889.*

Professor A. P. Thomas, Vice-president, in the chair.

A discussion arose on the desirability of again pressing on the notice of the Government the suitability of constituting Little Barrier Island a reserve for preserving the native flora and fauna of New Zealand; and on the motion of the Chairman, seconded by Dr. Purchas, a resolution to that effect was unanimously agreed to.

Papers.—1. "On Maori Proverbs," by Judge T. H. Smith. (*Transactions*, p. 111.)

2. "On Two Species of *Aranea* New to Science, from the Jenolan Caves, New South Wales," by A. T. Urquhart. (*Transactions*, p. 236.)

3. "On Electric Bleaching," by Professor F. D. Brown.

4. "On the Disappearance of the Moa," by Major W. G. Mair. (*Transactions*, p. 70.)

TWELFTH MEETING: *25th November, 1889.*

J. Martin, F.G.S., President, in the chair.

Dr. Bond gave a lecture on "Athletics in their Relation to Social Development."

ANNUAL GENERAL MEETING: *17th February, 1890.*

J. Martin, F.G.S., President, in the chair.

New Member.—Sir W. Fox.

ABSTRACT OF ANNUAL REPORT.

Twelve new members were added to the roll during the year. The number of withdrawals was 28, and the number of members is now 216. Allusion is made to the death of Mr. Justice Gillies, one of the founders of the Institute, and for many years one of its most liberal supporters.

The revenue for the year was £909 9s. 2d. The members' subscriptions yielded £173 5s., and the invested funds of the Costley bequest £539 3s. 9d. The total expenditure amounted to £704 14s. 8d., leaving a balance of £204 14s. 6d. in hand. The invested funds of the Institute amount to £10,718.

Twelve meetings were held during the session, at which 21 papers on scientific and literary subjects were read.

The chief additions to the Museum and Library were alluded to, and mention was made of the desirability of completing the Maori ethnological collections in the Museum.

ELECTION OF OFFICERS FOR 1890.—*President*—James Stewart, C.E.; *Vice-presidents*—Josiah Martin, F.G.S., S. Percy Smith, F.R.G.S.; *Council*—W. Berry, Professor F. D. Brown, C. Cooper, T. Humphries, E. A. Mackechnie, T. Peacock, M.H.R., J. A. Pond, Rev. A. G. Purchas, M.R.C.S.E., J. B. Russell, Professor A. P. Thomas, F.L.S., Rev. W. Tebbs; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

FIRST MEETING: *2nd May, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

Paper.—"Notes on the Habits of the New Zealand Bush-rat," by J. Rutland; communicated by Professor F. W. Hutton. (*Transactions*, p. 300.)

At the close of the meeting Mr. H. O. Forbes, F.R.G.S., exhibited and made a few remarks on the shoulder-girdles of *Aptornis* and *Cnemiornis*. He pointed out that the bone described by Sir Richard Owen ("Extinct Birds of New Zealand," p. 377, and pl. ciii.) as the coracoid of *Cnemiornis* is in reality the coracoid of *Aptornis defossor*, and that the true coracoid of *Cnemiornis* closely resembles the same bone in *Cereopsis* and *Tachyeres*.

SECOND MEETING: *6th June, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

Paper.—"Note on the Geology of the Country about Lyell," by Professor F. W. Hutton. (*Transactions*, p. 387.)

This paper was illustrated by rock-sections for the microscope.

THIRD MEETING: *4th July, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

Professor Hutton gave an address entitled "Soils, and Geological Fertilizers." A considerable discussion followed.

Paper.—"On the Analysis of a Mineral Water from the Otira Gorge," by G. Gray. (*Transactions*, p. 495.)

FOURTH MEETING: *1st August, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

Mr. Forbes, F.R.G.S., delivered a popular lecture upon "The Physical Characters, Climate, Products, People, and Prospects of the British Possessions in New Guinea, with some Personal Experiences of Travel there."

The lecture was illustrated with lime-light views; and a number of ethnological and other specimens were exhibited.

FIFTH MEETING: *5th September, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

Papers.—1. "On the Origin of the Loess Deposit of Timaru," by J. Hardcastle; communicated by the Secretary. (*Transactions*, p. 406.)

2. "On a New Genus of Fishes of the Family *Percidæ*, from New Zealand," by H. O. Forbes, F.R.G.S. (*Transactions*, p. 273.)

SIXTH MEETING: *3rd October, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

New Member.—J. Hardcastle.

Papers.—1. "On the Relative Ages of the Coalfields of New Zealand," by Professor F. W. Hutton. (*Transactions*, p. 377.)

2. "A List of the New Zealand Fishes," by Professor F. W. Hutton. (*Transactions*, p. 275.)

3. "On the Newly-opened Cave near Sumner," by J. T. Meeson, B.A. (*Transactions*, p. 64.)

ANNUAL MEETING: *7th November, 1889.*

H. R. Webb, F.R.M.S., President, in the chair.

New Member.—B. Bull.

Papers.—1. "Descriptions of New Species of New Zealand Land and Fresh-water Shells," by H. Suter, Mount Cook Hermitage; communicated by Professor F. W. Hutton. (*Transactions*, p. 221.)

2. "Descriptions of New Zealand *Lepidoptera*," by E. Meyrick, F.E.S. (*Transactions*, p. 204.)

The annual report and balance-sheet were read and adopted.

ABSTRACT.

During the year seven ordinary meetings were held, at which eleven papers were read. In addition, several popular lectures were delivered.

During the session two new members joined the Institute, and twenty-three names were struck off the roll, thus leaving a membership of eighty-six.

During the year a number of the old members were removed by death, amongst them being Mr. J. B. Stansell, who was for many years librarian to the Institute.

The balance-sheet shows a total receipt of £99 3s. 2d., and a total expenditure of £94 5s. 7d., thus leaving a credit balance of £4 17s. 7d. The reserve, consisting of the subscriptions of life-members, now amounts to £70 13s. 3d.

Election of Officers for 1890.—*President*—S. Hurst-Seager, A.R.I.B.A.; *Vice-presidents*—H. R. Webb, F.R.M.S., J. T. Meeson, B.A.; *Treasurer*—J. T. Meeson, B.A.; *Secretary*—R. M. Laing, M.A., B.Sc.; *Council*—Professor F. W. Hutton, Dr. Symes, T. W. Naylor Beckett, F.L.S., B. Bull, R. W. Fereday, F.E.S.

It was moved by Professor Hutton, and unanimously resolved, "That the Philosophical Institute of Canterbury forward an invitation to the Australasian Association for the Advancement of Science, asking it to meet in Christchurch in January, 1891."

The retiring President then gave an address summing up the work of the year.

Special Meeting: *21st November, 1889.*

S. Hurst-Seager, A.R.I.B.A., President, in the chair.

Papers.—1. "Some Simple Experiments to illustrate Force, Energy, Momentum, &c.," by Professor F. W. Bickerton.

2. "A Method of explaining the Phenomena of Dissociation, and some of the Peculiarities of the Isothermals of Gases, by means of Molecular Attraction," by Professor F. W. Bickerton.

3. "On some of the Results of the Impact of Spherical Nebulæ," by Professor F. W. Bickerton.

OTAGO INSTITUTE.

First Meeting: *11th June, 1889.*

Dr. de Zouche, President, in the chair.

New Members.—J. Hendry, B.A.; G. D. Braik, M.A.; D. A. Graham.

Papers.—1. "Observations on the Mokohinou Islands, and the Birds which visit them," by F. Sandager. (*Transactions*, p. 286.)

2. "Note on the Fœtal Membranes of *Mustelus antarcticus*," by Professor T. J. Parker, F.R.S.; with an Analysis of the Pseudamniotic Fluid, by Professor A. Liversidge, F.R.S. (*Transactions*, p. 331.)

3. "On some New Plants found in the Otago District," by D. Petrie. (*Transactions*, p. 439.)

Resolved: (1.) That, as no work dealing with the systematic botany of New Zealand is now available at a reasonable price, this Institute brings under the notice of the New Zealand Institute the desirability of urging the Government to undertake as early as possible the publication of a "Flora of New Zealand." (2.) That the other affiliated branches of the New Zealand Institute be asked to co-operate in this matter. (3.) That the Secretary also be requested to bring the matter directly under the notice of the Government.

Exhibits.—A specimen of Drew's perch, and a bird's skeleton prepared for teaching purposes, by Professor Parker.

Second Meeting: *9th July, 1889.*

Dr. de Zouche, President, in the chair.

Paper.—"Description of a New Species of *Celmisia*," by F. R. Chapman; illustrated by numerous living specimens. (*Transactions*, p. 444.)

Exhibits.—A rocking microtome, by Dr. Scott. Frozen sections of the red cod, by Professor Parker.

Third Meeting: *12th August, 1889.*

Dr. de Zouche, President, in the chair.

New Members.—Dr. Macpherson, A. Boot.

Papers.—1. "Notes on a Paper entitled 'The Takahe in Western Otago,' by James Park, F.G.S.," by E. Melland. (*Transactions*, p. 295.)

2. "A Chapter of German Literature," by Dr. Bülau.

Fourth Meeting: *10th September, 1889.*

Dr. de Zouche, President, in the chair.

Paper.—"On the Development of the Kiwi," by Professor Parker.

Fifth Meeting: *8th October, 1889.*

Dr. de Zouche, President, in the chair.

Paper.—"Notes on the Land-system of the Iliad," by Henry Belcher, Fellow of King's College, London, Rector of the High School, Otago. (*Transactions*, p. 21.)

Annual Meeting: *12th November, 1889.*

Dr. de Zouche, President, in the chair.

Papers.—1. "Revision of the New Zealand *Idoteidæ*," by Charles Chilton, M.A., B.Sc. (*Transactions*, p. 189.)

2. "On Parasitic Forms of *Crustacea Entomostraca*," by G. M. Thomson. (*Transactions*, p. 353.)

3. "Descriptions of New Species of New Zealand *Araneæ*, with Notes on their Habits," by P. Goyen, F.L.S. (*Transactions*, p. 267.)

The annual report and balance-sheet were read and adopted.

The balance-sheet shows that the total receipts, including a balance of £82 17s. 5d. from last year, were £212 10s. 11d., and the expenditure £136 8s. 10d., thus leaving a credit balance of £76 2s. 1d. The Institute has also a fixed deposit of £254 9s. 2d.

Election of Officers for 1890. — *President* — Dr. Belcher; *Vice-presidents* — Dr. de Zouche, Dr. Hocken; *Council* — Messrs. Chapman, Wilson, Petrie, Scott, Parker, Adams, G. M. Thomson; *Secretary*—Professor Gibbons; *Treasurer*—E. Melland; *Auditor*—D. Brent.

The retiring President then read an address on "Bacteria and their Relation to Disease." (*Transactions*, p. 31.)

WESTLAND INSTITUTE.

Annual Meeting: *11th December, 1889.*

Abstract of Annual Report.

The Trustees, in presenting the twenty-third annual report, state that the year has been an uneventful one.

The Borough Council voted the sum of £25 to the Institute in 1888, and in the past year £20.

The roll shows that there are seventy-one members, which is considered a fair number.

There have been ten ordinary meetings and one special meeting, which have been generally well attended.

One hundred and ninety volumes of useful works have been added to the library by purchase, including twenty-two volumes of the "Encyclopædia Britannica;" while several donations of a valuable nature have been made.

The Trustees return thanks to those proprietors who donate newspapers to the Institute.

The balance-sheet shows that the total receipts, including a balance from the previous year of £7 6s. 11d., amounted to £126 7s. 7d., while the expenditure was £113 14s.; leaving a balance in hand of £12 13s. 7d.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

First Meeting: *13th May, 1889.*

Papers.—1. Inaugural address by the President, Dr. W. I. Spencer.

The subject of the address was "Movement and Sensation in Plants." In the course of it the President stated that it was intended to form sections for the study of local geology and botany, and also a microscopical section.

2. "A Description of some Newly-discovered Phænogamic Plants, being a Further Contribution towards the making-known the Botany of New Zealand," by W. Colenso, F.R.S., F.L.S., &c. (*Transactions*, p. 459.)

Mr. Hamilton exhibited living specimens of the small and curious orchid described in Mr. Colenso's paper as *Bolbophyllum tuberculatum*, Col. Mr. Hamilton also showed a block of very good diatomaceous earth from the Makaretu district, a specimen of *Squilla indefensa*, and a pair of wetas from the caves at Ormondville.

Second Meeting: *1st June, 1889.*

Papers.—1. "A Legend of the Large Australian Screech-owl, called by the Australian Natives Ti-na-tinity," by T. Pine.

2. "Plants and Astrology," by A. Hamilton.

3. "Notes on some New Zealand Ferns," by A. Hamilton. (*Transactions*, p. 493.)

A number of specimens recently added to the Museum were laid on the table for the inspection of the visitors. Amongst them was a fine carapace of a turtle, presented by Mr. Prebble.

Third Meeting: *8th July, 1889.*

Papers.—1. "Shadow-pictures," by Taylor White. (*Transactions*, p. 108.)

Mr. Harding remarked, in the discussion which followed, that moonlight, passing through any irregularly-shaped small aperture, always produced a circular patch of light.

2. "A Description of Two Newly-discovered Indigenous Cryptogamic Plants." by W. Colenso, F.R.S., F.L.S., &c. (*Transactions*, p. 449.)

Several specimens of those two plants were exhibited by Mr. Colenso; and also fine specimens of the following indigenous and rare fungi collected by him, in very good preservation: *Hydnum novæ-zealandiæ*, Col., sp. nov.;* *Hirneola polytricha*, Mont.; *Aseroe corrugata*, Col., sp. nov.;† *Ileodictyon cibarium*, Tulasne; *Secotium erythrocephalum*, Tulasne.

3. "On the Large Meteor of the 4th May, 1888," by Taylor White. (*Transactions*, p. 105.)

Mr. H. Hill then brought before the meeting the desirability of forming a small Field Naturalists' Club or Society in connection with this branch of the Institute, and pointed out the desirability of promoting active and intelligent observation of the natural history of our country, and the use such a society might be to the Institute.

The Secretary exhibited several trays of small but beautiful corals of various forms and colours, including the precious red coral of commerce, from his private collections.

FOURTH MEETING: *12th August, 1889.*

Papers.—1. "On the Wild Dogs of New Zealand," by Taylor White. (*Transactions*, p. 327.)

In the discussion which followed, Mr. J. T. Large, of the Wairoa, said that from all he had heard of the dog from the natives he believed that the animal was a small one, and extremely docile, not to say spiritless, which might be accounted for by the fact that the animal lived almost exclusively on fish and vegetable diet. The dog was reared by the natives for its hair and for food; and he did not agree with the writer in thinking that the animals killed by him were Maori dogs.

Mr. Hamilton said that he had seen several wild dogs shot on the high bush-lands at the back of Horokiwi, near Wellington, which agreed very well with Mr. White's description of those shot by him in the South; but he had never considered them other than dogs escaped from domestication, or the descendants of such. He thought that, as the pig introduced by Europeans got plentiful, the dog, used till then as a *kinaki* or relish to the ordinary vegetable diet of the natives, was allowed to die out and eventually to disappear.

2. "Notes on Two Birds recently shot at Napier," by A. Hamilton.

The one was a white-eyed duck (*Nyroca australis*), shot at Te Aute; the other a good specimen of the spotted shag (*Phalacrocorax punctatus*), shot at the Port.

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* "Trans. N.Z. Inst.," vol. xxi., p. 79.
† "Trans. N.Z. Inst.," vol. xvi., p. 362.

Mr. Hamilton exhibited a very large kiwi-egg, sent to the Museum by Mr. Brill, of Tarawera; and also a number of carved perches and snares for native birds from the Taupo district.

3. "On the *Diatomaceæ*," by W. I. Spencer.

Dr. Spencer gave an interesting address on diatoms found in the vicinity of Napier; and in the course of his remarks proposed a new theory to account for the curious motions of some of the diatoms.

Fifth Meeting: *9th September, 1889.*

Papers.—1. "On Sponges, their Life-history," by A. Hamilton.

2. "On some of the peculiar and little-known Arts of the Old New-Zealanders," by W. Colenso, F.R.S., F.L.S.

This paper was not completed, and will be finished by Mr. Colenso at a future meeting.

Sixth Meeting: *7th October, 1889.*

Papers.—1. "The Artesian-well System of Hawke's Bay," by H. Hill, F.G.S. (*Transactions*, p. 429.)

2. "A Description of some Newly-discovered Indigenous Phænogamic Plants, being a Further Contribution towards the making-known the Botany of New Zealand," by W. Colenso, F.R.S., F.L.S. (*Transactions*, p. 459.)

3. "A Description of some Newly-discovered Indigenous Cryptogamic Plants," by W. Colenso, F.R.S., F.L.S. (*Transactions*, p. 452.)

Specimens of these plants were at the same time exhibited by the describer.

4. "Descriptive Geology of the District between Napier and Ruapehu Mountain *viâ* Kuripapanga and Erehwon," by H. Hill, B.A. (*Transactions*, p. 422.)

5. "On the Deposit of Moa-bones at Te Aute," by A. Hamilton. Part III.

6. "Contributions to the List of New Zealand Fishes, being a List of the Fishes recorded on the East Coast of New Zealand," by A. Hamilton.

Annual Meeting: *February, 1890.*

Dr. Spencer, President, in the chair.

Abstract of Annual Report.

Six ordinary meetings were held and were fairly attended. The number of papers read was twenty-one. The museum has received numerous donations and many valuable deposits, especially in the department of Maori archæological articles. By request of the authorities of the New Zealand Exhibition Mr. Hamilton, the Curator, went to Dunedin to superintend the arrangement of the Maori and early-history court; and a large number of the principal exhibits (about 250) in this court are from the museum of this Society, and are noted by southern papers as of the highest value and interest. Mr. Hamilton was also able to obtain while in Otago some very good bones of the moa, which will assist in completing the important series of bones from Te Aute. He has also arranged for a further accession after the close of the Exhibition. The President, Dr. Spencer, has, in accordance with a suggestion made by him in his presidential address, formed a microscopical section, and fortnightly meetings have been held. A course of lectures on the use of the microscope was also delivered by him at these meetings.

The balance-sheet presented last year showed a debit balance of £41 3s., while on the 31st of January, 1890, there was a small credit balance.

During the year 2 members have died, 7 have resigned, 7 have left the district, and 1 new member has been elected, leaving the membership at 100. Three Council meetings were held during the year.

Election of Officers for 1890.—*President*—Dr. Spencer; *Vice-president*—H. Hill; *Treasurer*—R. C. Harding; *Council*—Dr. Moore, A. V. McDonald, J. S. Large, J. T. Carr, W. J. Birch, R. Lamb; *Secretary and Curator*—A. Hamilton; *Auditor*—T. K. Newton.

NELSON PHILOSOPHICAL SOCIETY.

First Meeting: *4th April, 1889.*

The Bishop of Nelson, President, in the chair.

The President addressed the meeting on his re-election to that office.

Exhibits.—The Curator exhibited a specimen of German-tinder (*Polyporus fomentarius*) presented by Mr. Martin, of Pigeon Valley. The Secretary exhibited a European specimen of the same, describing its uses in medicine and its commercial value. The Curator exhibited specimens—viz., awaruite, gold-bearing quartz from Collingwood, aragonite and fossil shells from the same place. The President exhibited a beautiful specimen of *Eucalyptus ficifolia* in blossom.

Paper.—"The Wattle-blight (*Icerya purchasi*) in Tasmania, and its Natural Enemies," by James Hudson, M.B., Lond. (*Transactions*, p. 176.)

Second Meeting: *4th June, 1889.*

The Bishop of Nelson, President, in the chair.

Exhibit.—The Curator exhibited a photograph of the total eclipse of the sun (1st January, 1889), presented by the Director of the Lick Observatory.

Papers.—1. "On the Snowy Owl (*Nyctea scandiaca*) and the Great Horned Owl (*Bubo virginianus*)," by Dr. Coleman.

Specimens of these birds were presented by the President.

2. "An Evening with the British Association, held at Bath, 1888," by the President.

Third Meeting: *8th July, 1889.*

A. S. Atkinson, Vice-president, in the chair.

New Members. — Rev. F. W. Chatterton, and J. W. Joynt, M.A., Principal of Nelson College.

Exhibits.—The Curator exhibited a Queensland war-club, specimens of asbestos from Mount Arthur, sago-palm nuts from Fiji, also skins of kiwi and kakapo.

A letter was read by the Secretary from Mr. Park, of the Geological Department, stating many of the advantages the Nelson District possessed for original scientific research.

Paper.—"Mind and Matter," by James Caird, D.D., D.C.L., Principal of the University of Glasgow, read before the British Medical Association, 1888.

Dr. Hudson called attention to the meteorological fact of the great difference of temperatures he had observed between the surface of the earth and some 4ft. above it.

Fourth Meeting: *12th August, 1889.*

The Bishop of Nelson, President, in the chair.

Exhibits.—Curious growth in an Arum, bloom being in triplicate, reported by Rev. A. R. Watson; specimens of fungi, *Polyporus fomentarius*, Colenso, exhibited by Mr. Hugh Martin, jun.; whale-barnacles, *Coronula diadema*, brittle star-fish, *Trochus*, *Calcar imperialis*, paper-nautili, *Haliotis*, bone tail of stingaree, sharks' eggs, teeth of fishes, jaw-plates of ditto, *Struthiolaria*, sea-horse, manuka showing markings by a cicada, all from Picton, exhibited by the Curator.

Paper.—"An Evening with the British Association, held at Bath, 1888," by the President (*concluded*).

Fifth Meeting: *16th September, 1889.*

The Bishop of Nelson, President, in the chair.

Exhibits.—Drawing of fresh-water *Medusa*, exhibited by the President, found in tank in Botanic Gardens, London; also fossils, by Mr. Harris, of Kumara; oxidized iron-pyrites and geological specimens, by Mr. Washbourne; fine specimen of flax, dressed by native women, by Miss Gascoigne.

Paper.—"A Theory on the Formation of Gold into Specks and Nuggets," by H. P. Washbourne. (*Transactions*, p. 400.)

Annual Meeting: *5th November, 1889.*

The Bishop of Nelson, President, in the chair.

New Member.—T. Blake-Huffam.

Abstract of Annual Report.

The Hon. Secretary's report showed that a greater interest had been taken in the Society than during the previous two years. The meetings had been better attended, and the discussions better maintained. Some

good practical work had also been done in the School of Mines connected with the Society, such as analyses, assaying, and instruction in mineralogy.

The report of the Hon. Curator, Mr. R. I. Kingsley, showed that the Museum was in good condition, and the list of contributions compared very favourably with those of previous years.

It was further reported that the accounts of the Society showed a credit balance.

Election of Officers for 1890.—*President*—The Bishop of Nelson; *Vice-presidents*—A. S. Atkinson and Dr. Boor; *Council*—J. Holloway, R. I. Kingsley, Rev. A. R. Watson, Dr. Cressey, and Dr. Mackie; *Hon. Treasurer*—Dr. Hudson; *Hon. Secretary*—Dr. Coleman; *Hon. Curator*—R. I. Kingsley.

Papers.—1. "On the Occurrence of the Black Vine Weevil (*Otiorhynchus sulcatus*) in Nelson, New Zealand," by R. I. Kingsley. (*Transactions*, p. 338.)

Mr. Holloway showed enlarged drawings of the larva and pupa, and living specimens under glass were also handed round.

Mr. Holloway stated that this was the most destructive of the weevils, and attacked shrubs as well. He would advise that a little carbolic solution be poured on the spot where they appeared thickest: they would not stand a second application.

Dr. Boor advised carbolic powder as being much better to handle; he had found it very efficacious for wood-lice.

Dr. Mackie had observed the same insect in his own garden.

2. "Alaska and the Mammoth," by T. Blake-Huffam.

This paper elicited considerable discussion.

3. "On a Specimen of the Great Ribbon-fish (*Regalecus argenteus*) taken in Nelson Harbour," by R. I. Kingsley. (*Transactions*, p. 333.)

APPENDIX.

Comparative Abstract for 1889 and Previous Years.

Stations.	Barometer at 9.30 a.m.		Temperature from Self-registering Instruments read in Morning for Twenty-four Hours previously.					Computed from Observations.		Rain.		Wind.		Cloud.
	Mean Reading.	Extreme Range.	Mean. Temp. in Shade.	Mean Daily Range of Temp.	Ex-treme Range of Temp.	Max. Temp. in Sun's Rays.	Min Temp. on Grass.	Mean Elastic Force of Vapour.	Mean Degree of Moisture (Saturation = 100).	Total Fall in Inches.	No. of Days on which Rain fell.	Average Daily Force in Miles for Year.	Maximum Velocity in Miles in any 24 hours, and Date.	Mean Amount (0 to 10).
Auckland...	30·071	1·830	59·5	13·0	42·0	145·0	30·0	·381	74	41·970	162	...	...	5·7
Previous 25 years ...	29·979	...	59·0	...	...	...	...	·369	73	42·251	186	...	...	
Wellington	30·004	1·899	55·3	13·5	48·5	139·0	23·0	·329	74	31·356	155	236	850 on 9th Mar., 17th Dec.	4·0
Previous 25 years ...	29·920	...	54·6	...	...	...	...	·336	72	51 549	160	...		
Dunedin	29·976	1·690	51·1	15·1	62·0	153·0	15·0	·301	79	23·446	131	136	720 on 11th Aug.	5·4
Previous 25 years ...	29·862	...	50·2	...	...	...	...	·276	74	35·379	163	...		

Average Temperature of Seasons, compared with those of the Previous Year.

Stations.	Spring. September, October, November,		Summer. December, January, February,		Autumn. March, April, May.		Winter. June, July, August.	
	1888.	1889.	1888.	1889.	1888.	1889.	1888.	1889.
Auckland	55·4	58·3	62·8	66·5	59·5	60·5	52·4	52 8
Wellington	52·8	54·8	59 3	62·7	55·8	56·1	49·5	47·7
Dunedin	49·3	51·6	57·0	60·5	49·6	51·6	43·3	40·3

GENERAL REMARKS FOR 1889.

JANUARY.—Very fine weather, with rainfall considerably below the average, and temperature rather in excess.

FEBRUARY.—In North rain in excess, but below the average in South; temperature in excess; rather strong wind.

MARCH.—Small rainfall in North, but generally showery over centre and in South, and windy, the temperature generally slightly below the average.

APRIL.—Generally fine weather throughout. Earthquake at Rotorua on 19th, at 12.30 p.m., slight, and at Wellington, 8 a.m., slight. Lunar halo on 16th.

MAY.—Fine seasonable weather; small rainfall in South. Earthquakes at Wellington on 13th and 27th, at 8 a.m., slight.

JUNE.—Excessive rain in North, and generally stormy weather; generally fine in South and cold; the temperature generally below the average.

JULY.—Generally showery weather in North, but little rain in South; moderate winds. Slight earthshakes at Rotorua on 20th, 21st, 22nd, 23rd, and 25th.

AUGUST.—A showery month, but rainfall below the average; some pleasant weather; at times windy. A slight earthshake at Rotorua on 13th.

SEPTEMBER.—In the North rainfall rather over the average, but deficient in the South; strong N.E. and N.W. winds prevailed; temperature rather above the average. Earthquake at Wellington on 19th, at 10.30 p.m., slight.

OCTOBER.—The early part of month showery, generally fine during the latter part; strong N.W. winds over centre; temperature about the average. A meteor observed in South on 30th.

NOVEMBER.—Very fine weather in North, rainfall much below average, rather in excess in South, with strong N.E. winds. Earthquake felt at Wellington on 29th, at 10 p.m., slight.

DECEMBER.—On the whole fine weather; rainfall under the average; strong N.E. and N.W. winds; temperature rather in excess. Earthquake at Wellington on 10th, at 5.35 p.m., sharp double shock.

RAINFALL TABLE, 1866 to 1889, showing Deviations from the Mean Annual Fall at Three Selected Stations for Northern, Central, and Southern Districts.

—	Auckland.		Wellington.		Dunedin.		Average of same Stations.	
Mean annual fall	43·179		51·790		34·672		43·210	
Years.	Above Av'ge.	Below Av'ge.	Above Av'ge.	Below Av'ge.	Above Av'ge.	Below Av'ge.	Above Av'ge.	Below Av'ge.
1866	..	1·17	..	10·69	..	5·67	..	5·85
1867	10·01	..	..	9·84	4·38	..	1·51	..
1868	5·91	..	3·72	..	..	·78	2·95	..
1869	9·63	..	4·98	..	..	1·75	4·27	..
1870	1·66	..	..	3·59	4·53	..	·86	..
1871	4·33	..	12·27	..	..	12·52	1·42	..
1872	..	1·07	..	·85	..	7·28	..	3·07
1873	..	1·93	3·19	..	1·15	..	·80	..
1874	..	8·15	1·71	..	..	5·93	..	4·13
1875	8·14	..	14·04	..	7·96	..	10·04	..
1876	·85	..	..	8·42	3·59	..	..	1·33
1877	..	2·80	·13	..	2·79	..	·04	..
1878	..	6·01	2·81	..	10·56	..	2·45	..
1879	2·96	..	5·65	..	7·43	..	5·34	..
1880	..	4·28	..	5·03	..	1·59	..	3·64
1881	..	8·94	..	1·66	..	8·27	..	6·29
1882	2·46	..	3·89	..	7·12	..	4·49	..
1883	8·80	..	..	..	3·26	..	4·29	..
1884	..	5·68	10·24	..	..	1·32	1·55	..
1885	..	15·04	..	14·97	..	10·07	..	13·37
1886	..	10·53	2·68	..	17·96	..	3·36	..
1887	..	5·46	5·17	..	4·47	..	1·39	..
1888	..	8·57	..	10·78	13·68	..	..	1·90
1889	..	1·20	..	20·43	..	11·22	..	10·96

RAINFALL for 1889, with Averages for same Months previous Twenty-two Years.

Months.	Auckland.		Wellington.		Lincoln, Canterbury.		Dunedin.	
	1889.	Av'ges. prev. Years.	1889.	Av'ges. prev. Years.	1889.	Av'ges. prev. Years.	1889.	Av'ges. prev. Years.
	In.	In.	In.	In.	In.	In.	In.	In.
January ..	·64	2·80	2·24	3·50	·41	2·27	·44	3·91
February ..	4·04	3·54	1·48	3·54	·05	2·00	·19	2·66
March ..	·70	2·63	3·97	2·81	4·18	1·80	2·42	2·72
April ..	1·04	2·82	1·31	3·52	1·60	1·80	1·83	2·19
May ..	5·41	4·08	·92	4·98	1·36	2·23	·90	3·64
June ..	10·41	4·77	4·03	5·21	2·84	3·11	1·94	3·64
July ..	4·38	4·81	3·14	6·10	1·65	2·60	1·55	2·44
August ..	2·59	4·63	2·59	5·20	·98	2·26	1·82	2·82
September	5·82	3·39	4·78	4·25	3·66	1·76	1·76	2·47
October ..	3·20	3·24	3·23	4·83	·49	1·72	1·67	2·48
November	1·11	2·75	·94	4·16	1·69	2·18	4·84	2·73
December	2·63	3·22	2·73	3·93	1·42	1·64	4·07	3·15
Totals ..	41·97	42·68	31·36	52·03	20·33	25·37	23·44	34·85

EARTHQUAKES reported in NEW ZEALAND during 1889.

PLACE.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Gisborne	..	..	..	..	..	24†	..	..	..	..	..	..	1
Napier	..	..	..	..	27	..	..	..	..	..	..	..	1
Rotorua	..	..	..	19	..	..	20, 21, 22, 23, 25	13	..	..	..	..	7
Marton	..	..	..	..	..	..	..	..	..	..	..	20*	1
Woodville	..	..	6*	..	27	12	..	..	..	..	..	10*	4
Masterton	..	..	6*	..	..	12	..	..	..	..	..	10*	3
Wellington ..	..	..	..	19	13, 27	..	..	..	19	..	29	10	6
Waipawa	..	..	..	..	27	..	..	..	..	..	..	..	1
Castlepoint ..	..	..	..	..	..	12	..	..	..	..	..	..	1
Feilding	..	..	6*	..	27	12	..	..	..	..	..	20*, 10*	5
Palmerston North ..	..	..	6*	..	27	..	..	..	..	..	..	..	2

NOTE.—The figures denote the day of the month on which one or more shocks were felt. Those with the asterisk affixed were described as *smart*, those with the dagger as *severe* shocks. The remainder were only slight tremors, and no doubt escaped record at most stations, there being no instrumental means employed for their detection. These tables are therefore not reliable as far as indicating the geographical distribution of the shocks.

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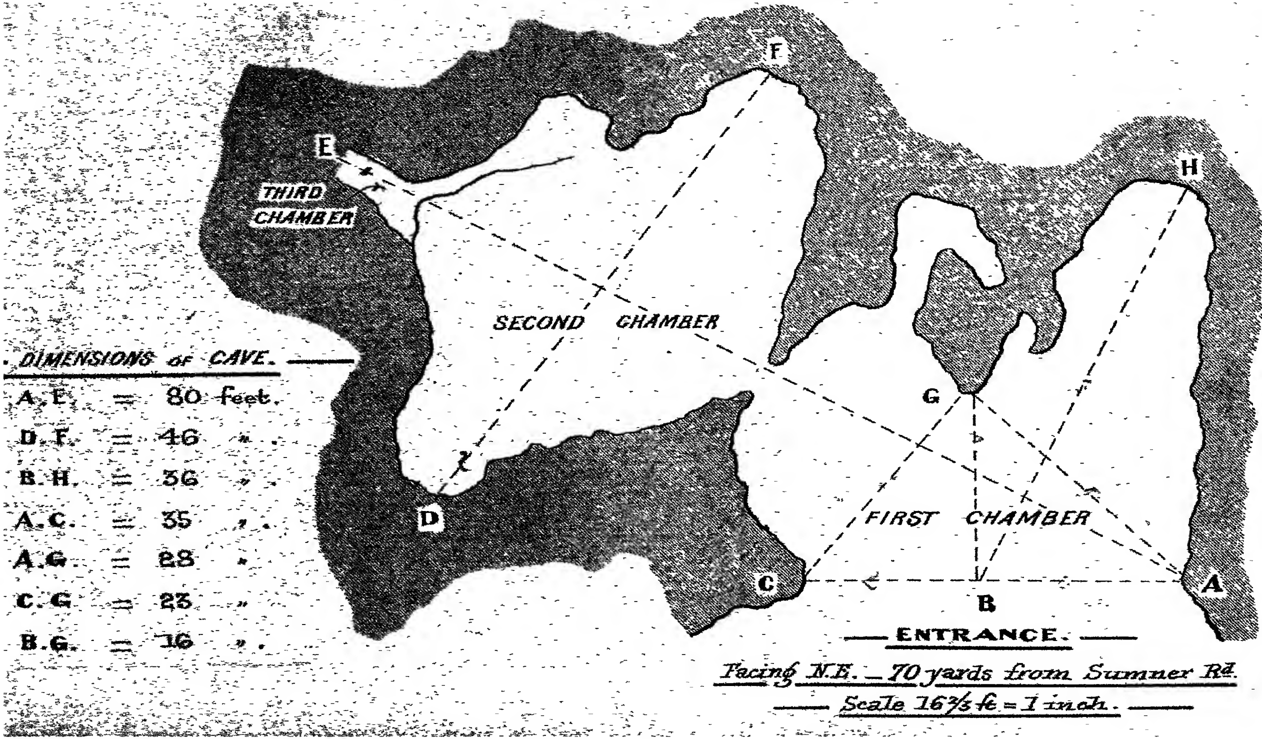
THIRD CHAMBER
SECOND CHAMBER
FIRST CHAMBER
E
F
H
G
D
C
B
A
DIMENSIONS of CAVE.
A.E. = 80 feet.
D.F. = 46 "
B.H. = 36 "
A.C. = 35 "
A.G. = 28 "
C.G. = 23 "
B.G. = 16 "
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Facing N.E. – 70 yards from Sumner Rd.
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ARTICLES FOUND IN MONCK'S CAVE near SUMNER

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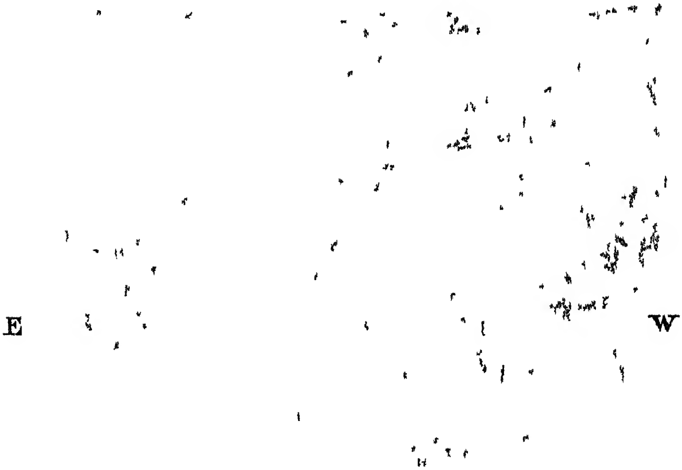


Fig 1

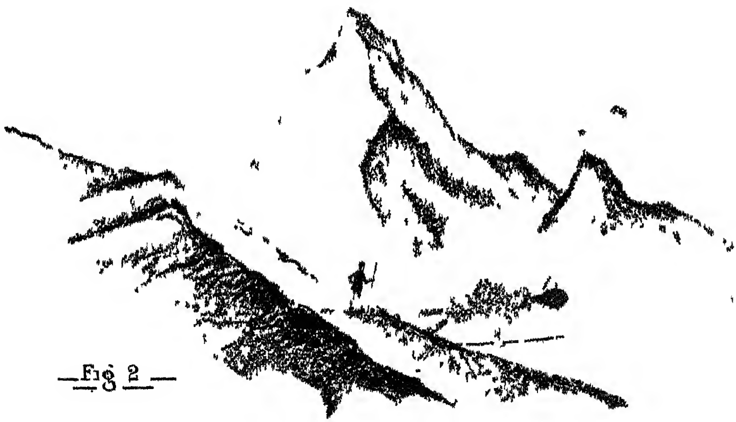
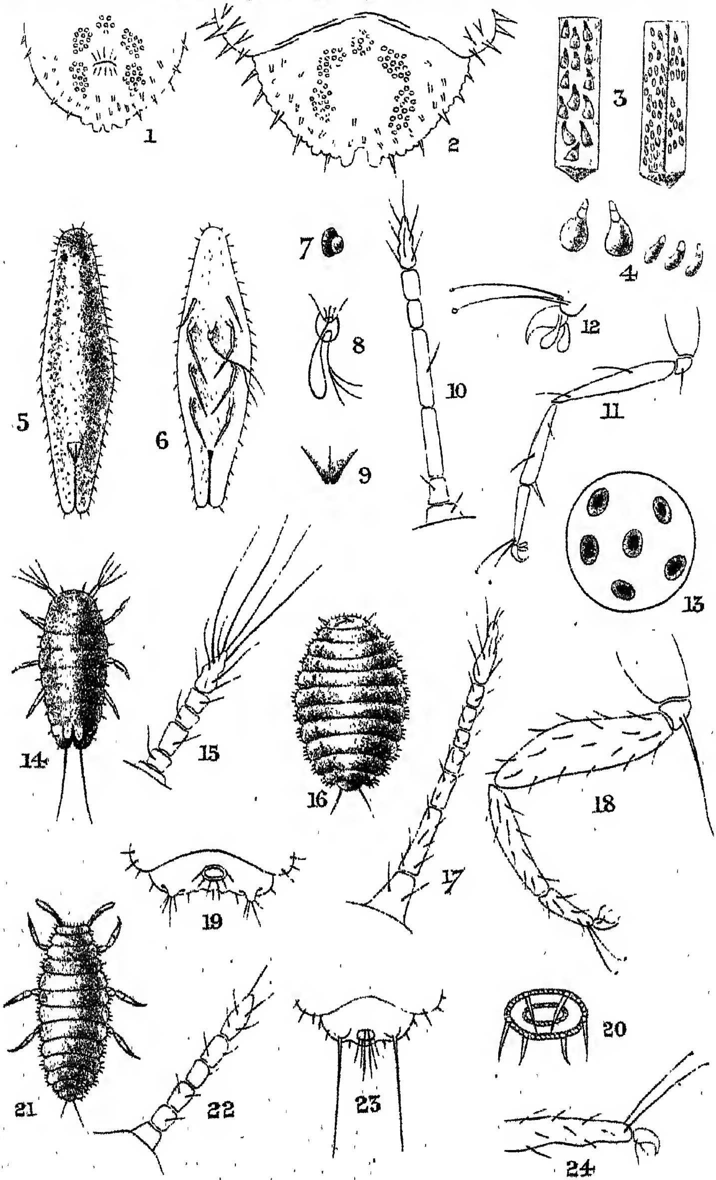


Fig 2

SHADOW PICTURES.

T W delt

C H P lith



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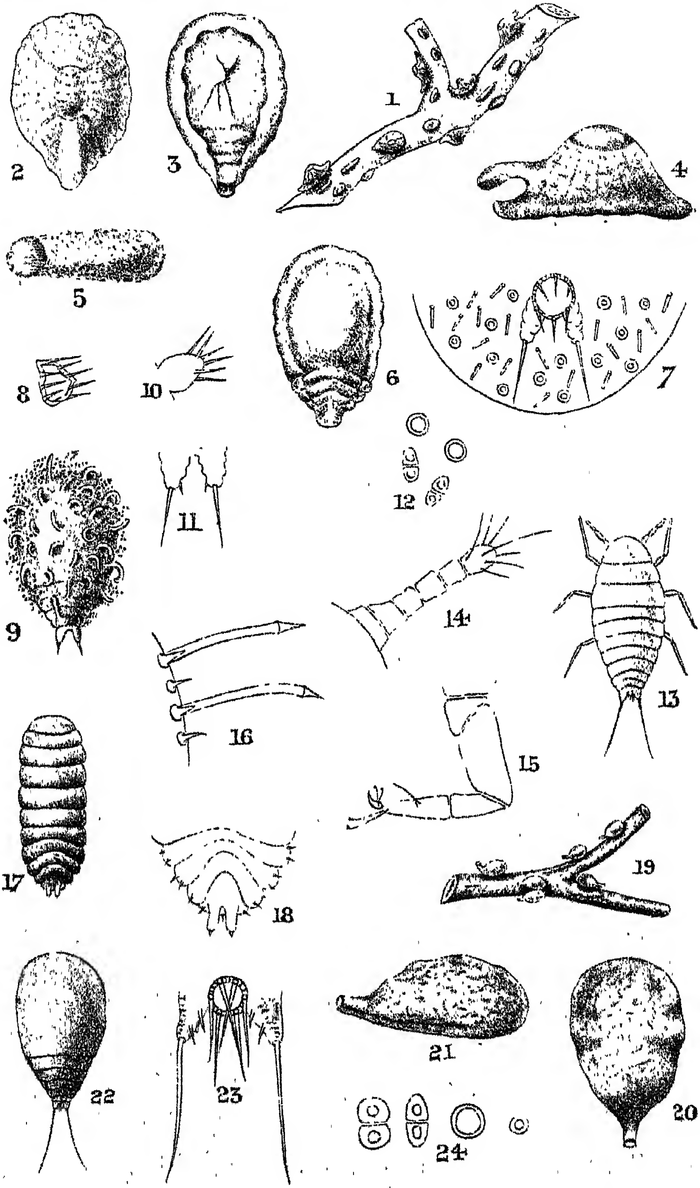

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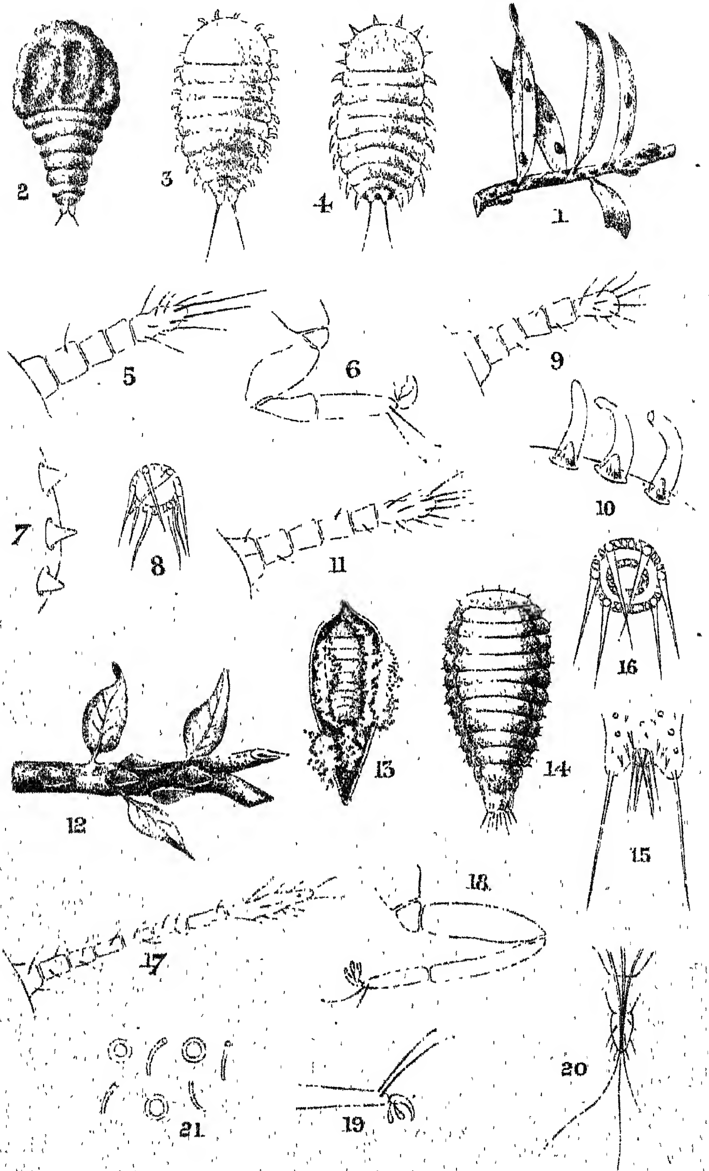

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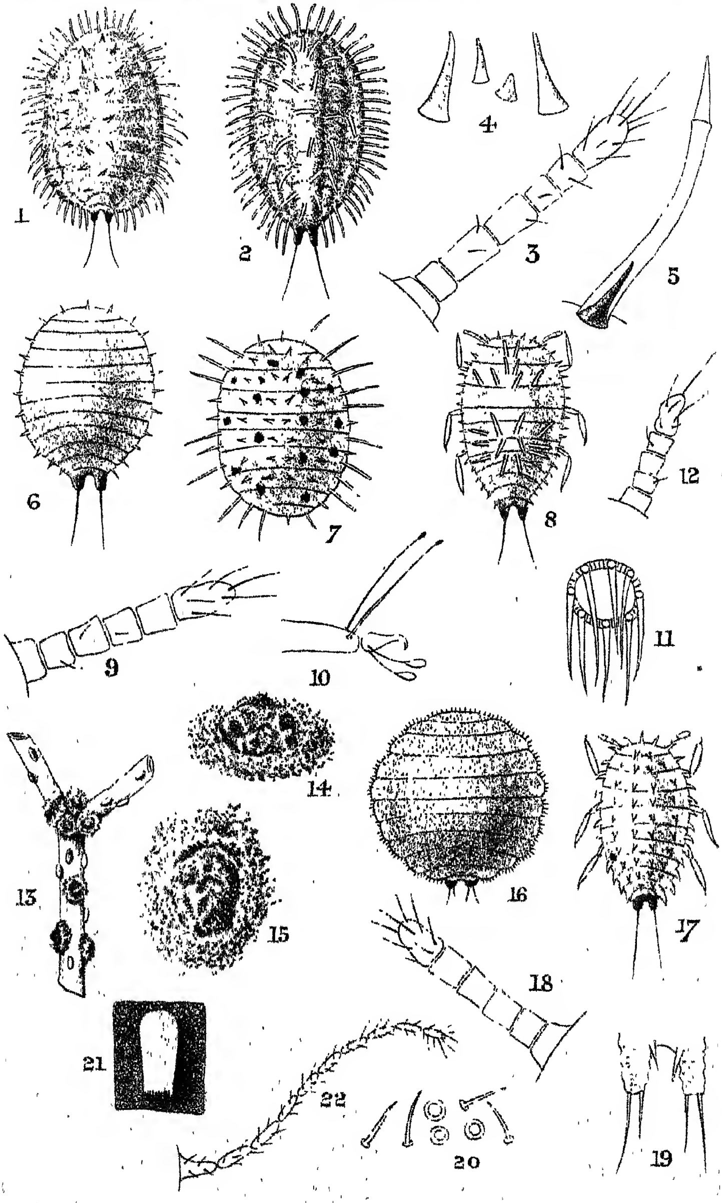

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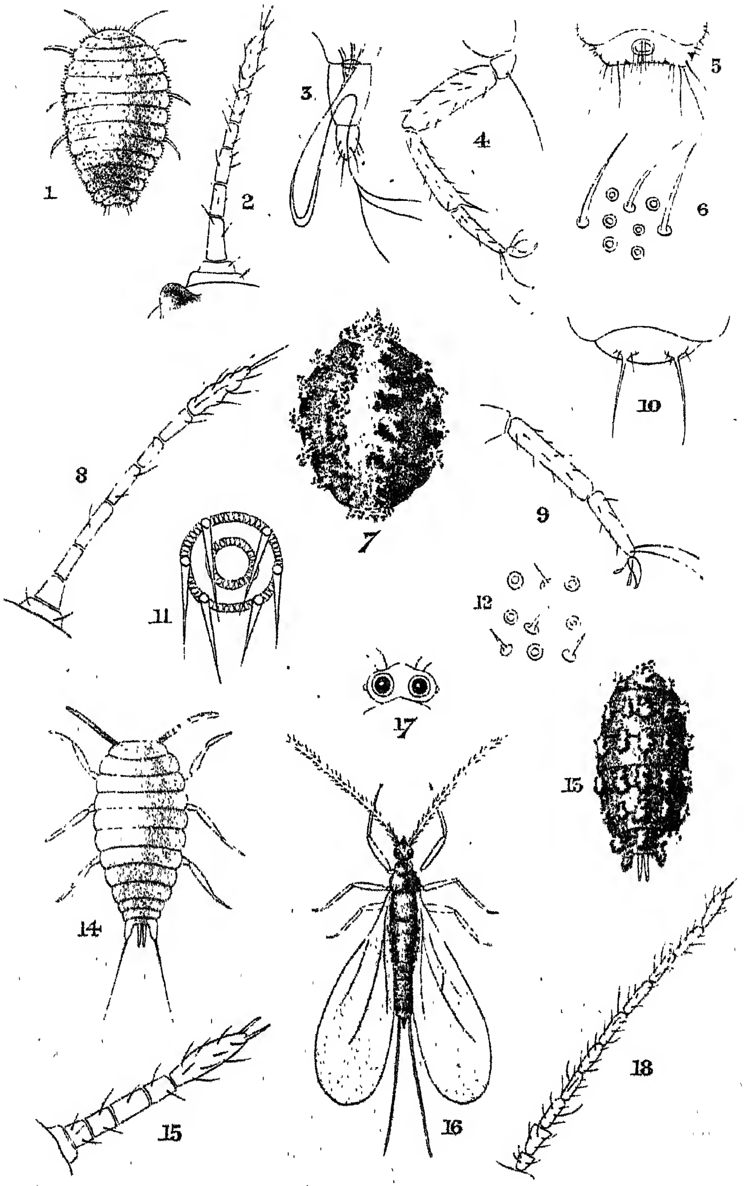

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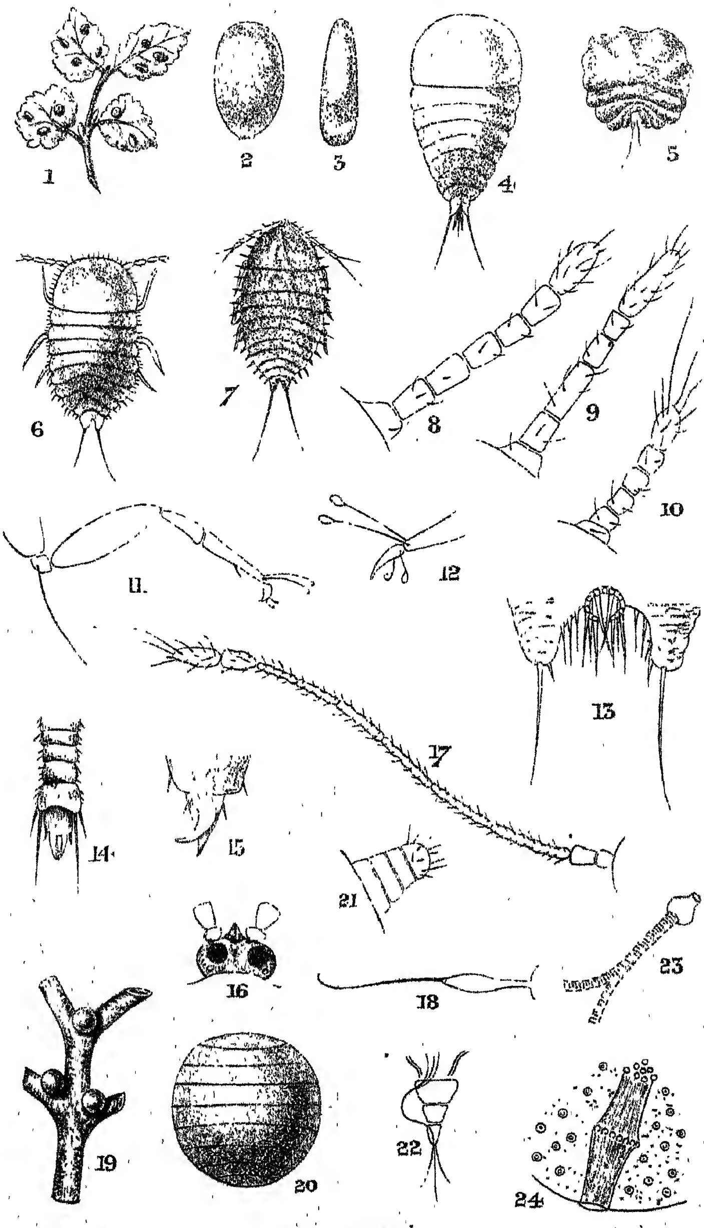

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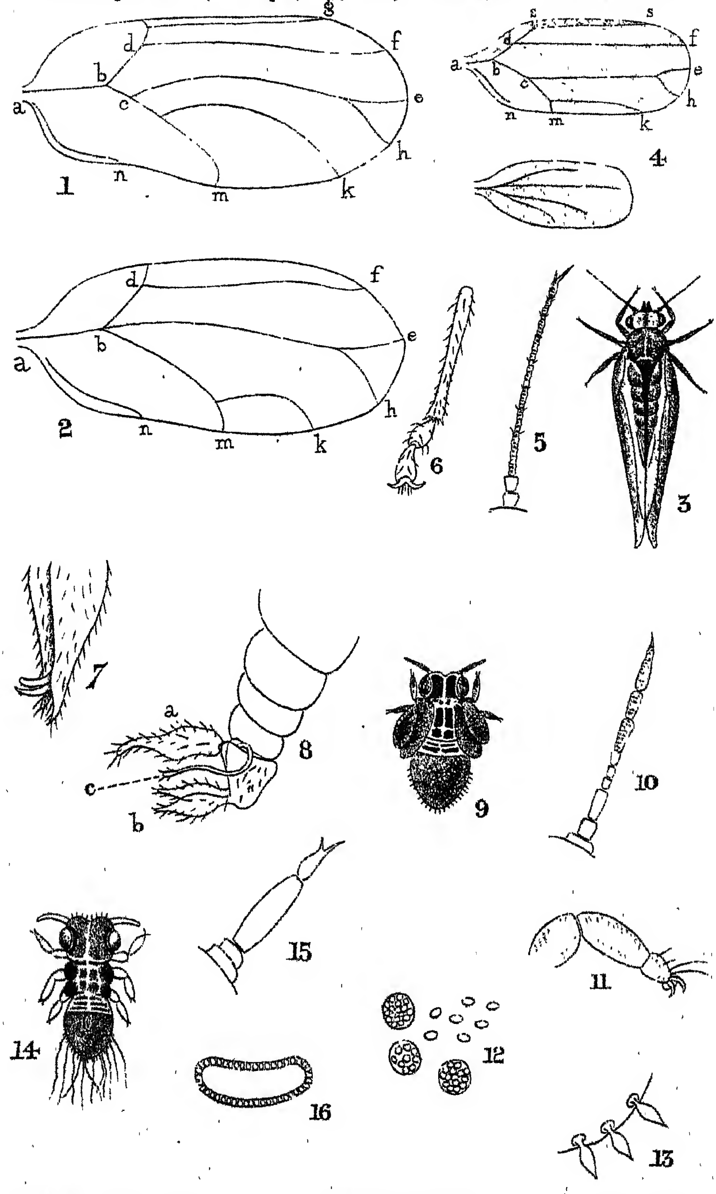

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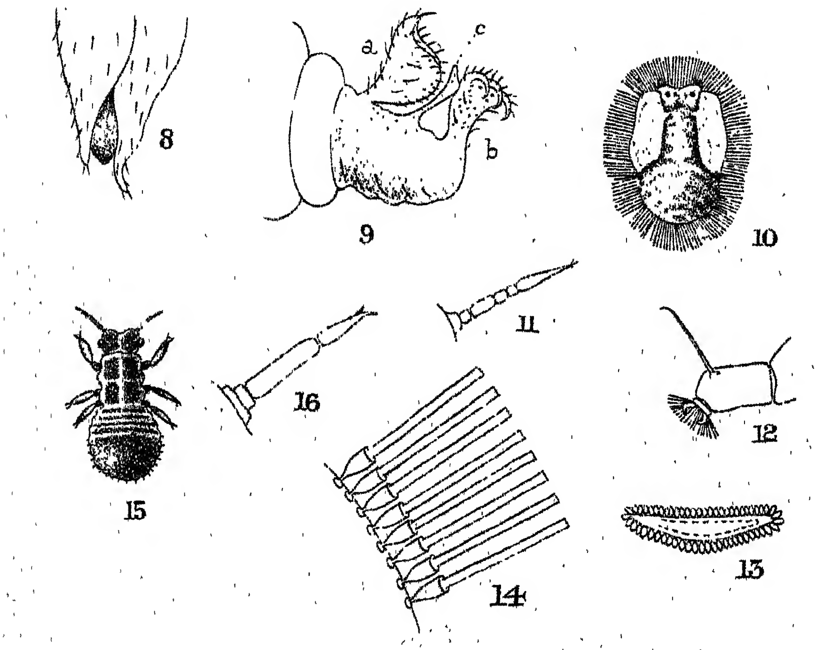

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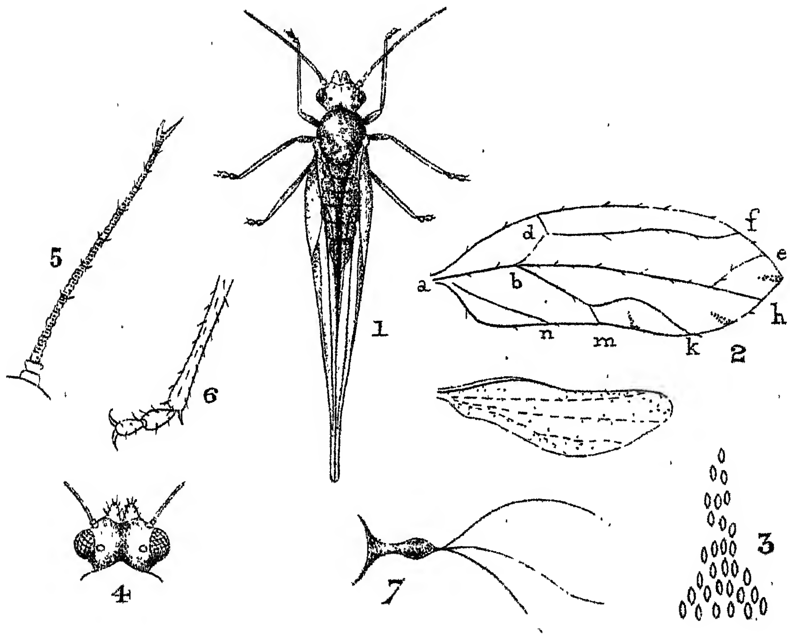
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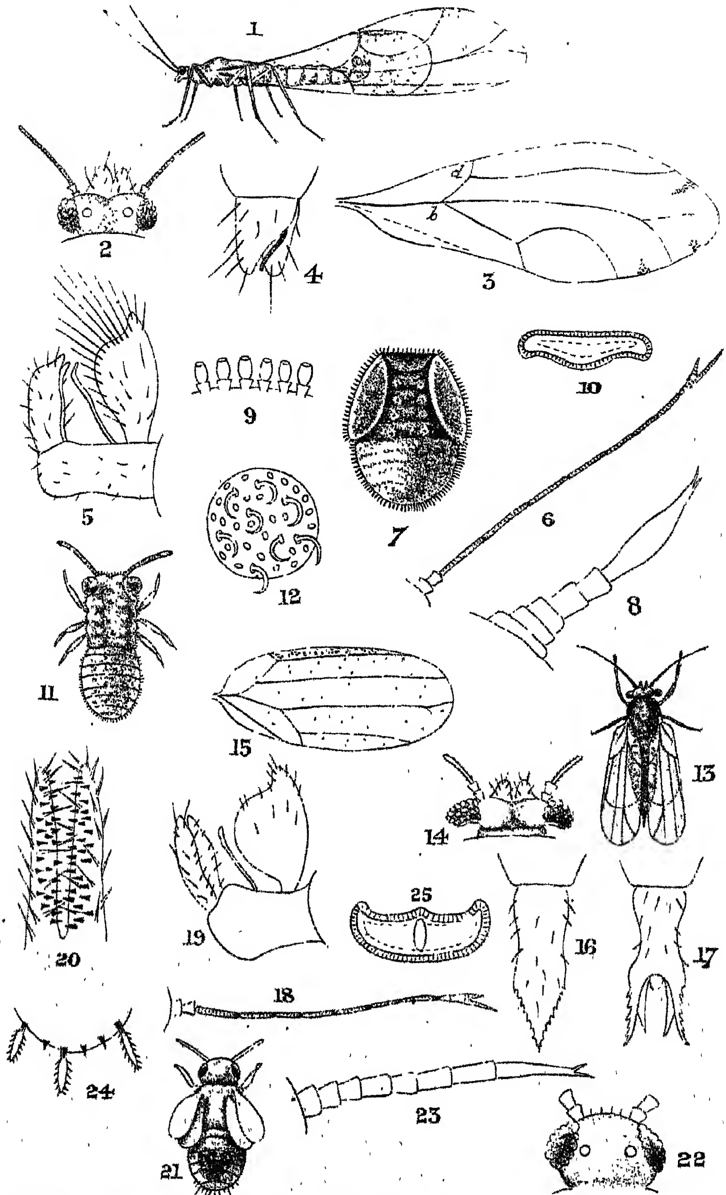

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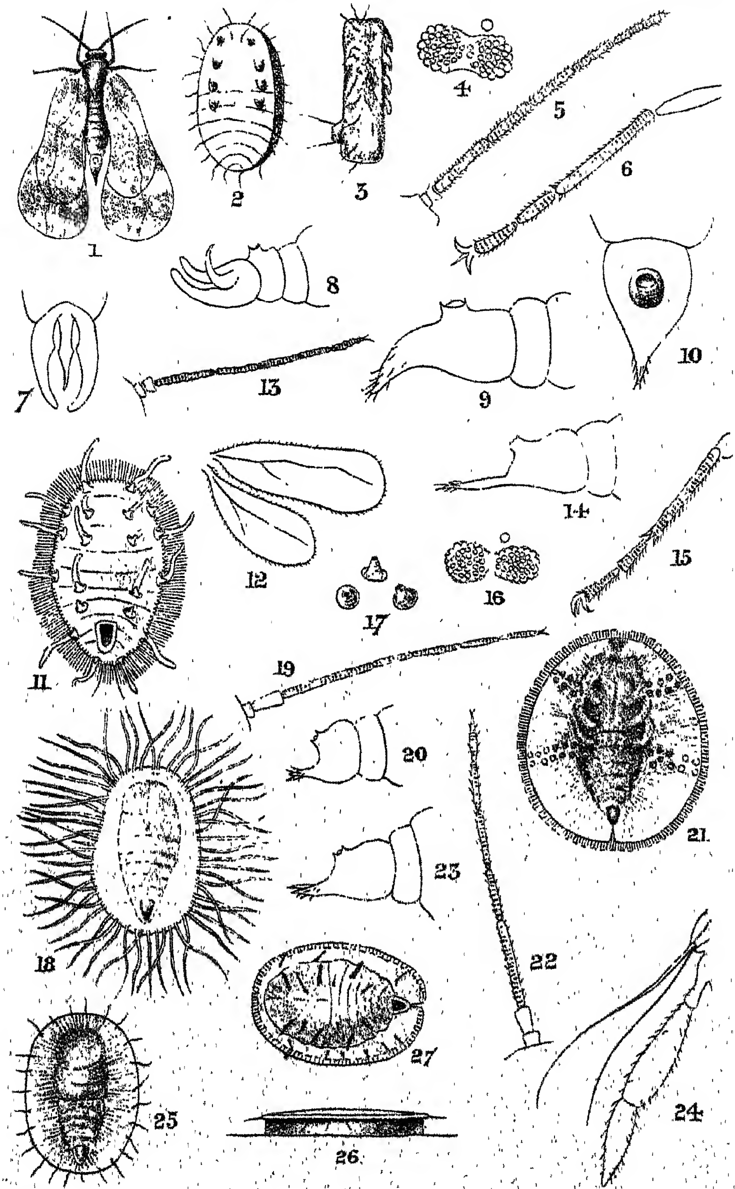
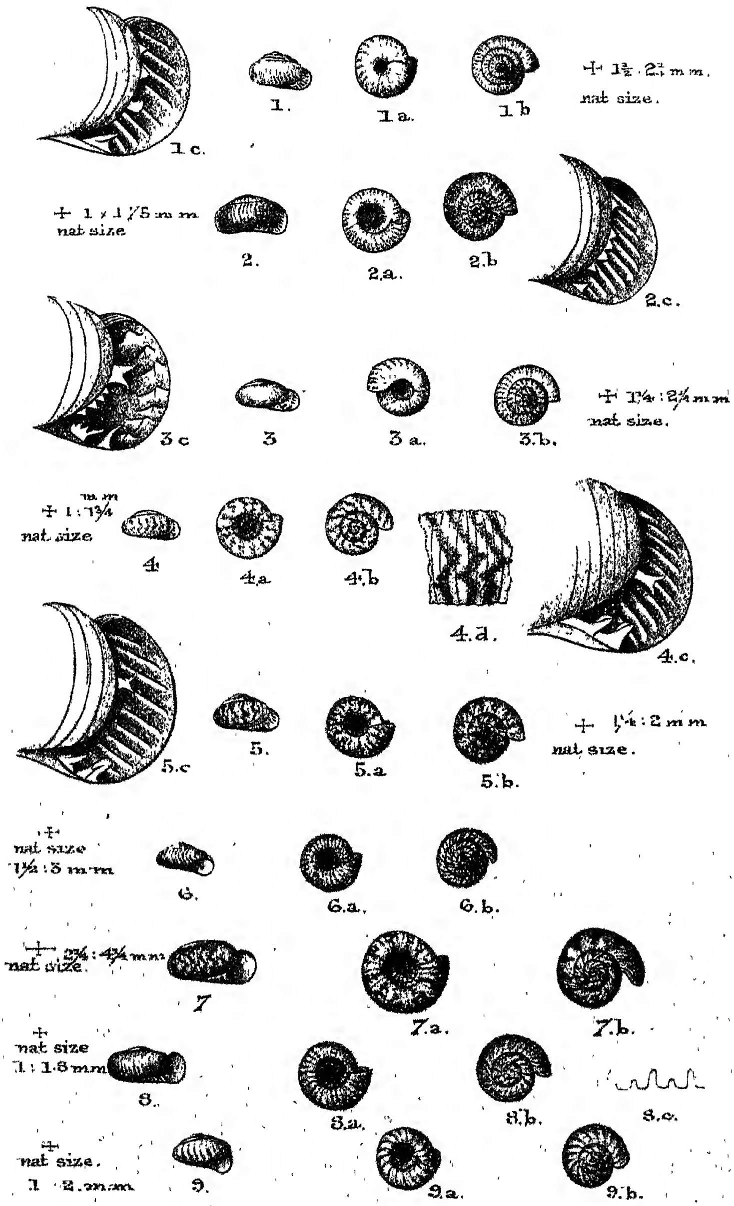
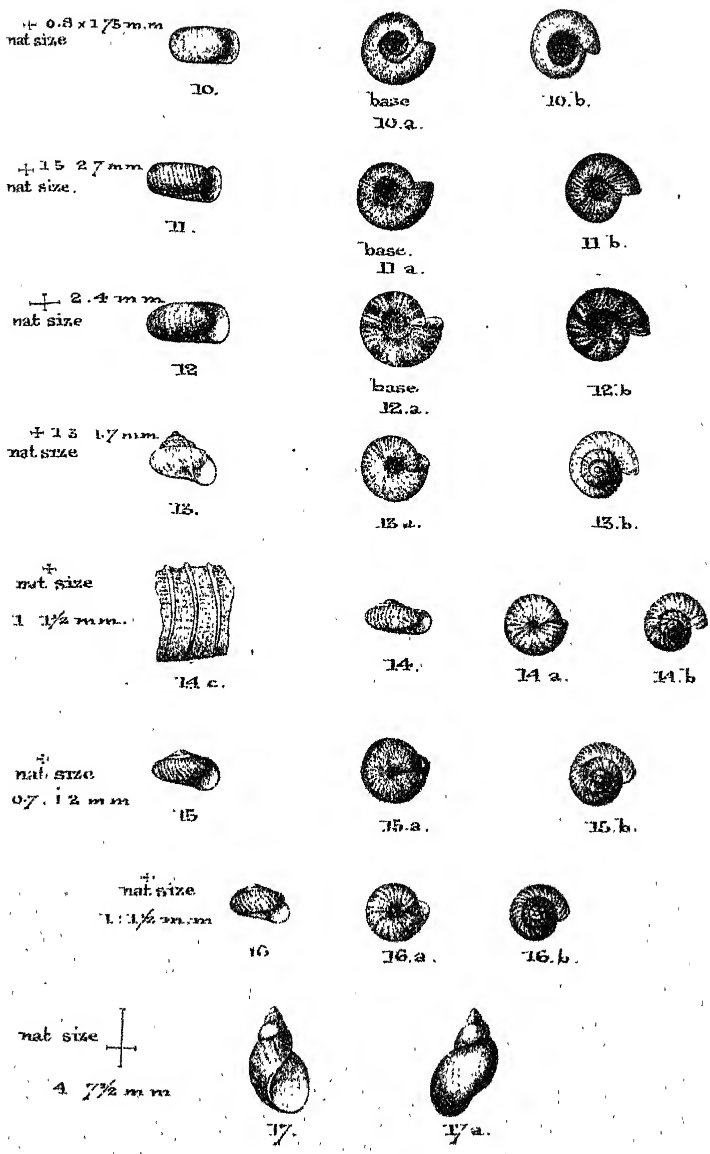


W.M.M. del. ad nat. ALEURODIDÆ. C.H.P. lith.



H.S. del. NEW ZEALAND LAND SHELLS. C.H.P. lith.



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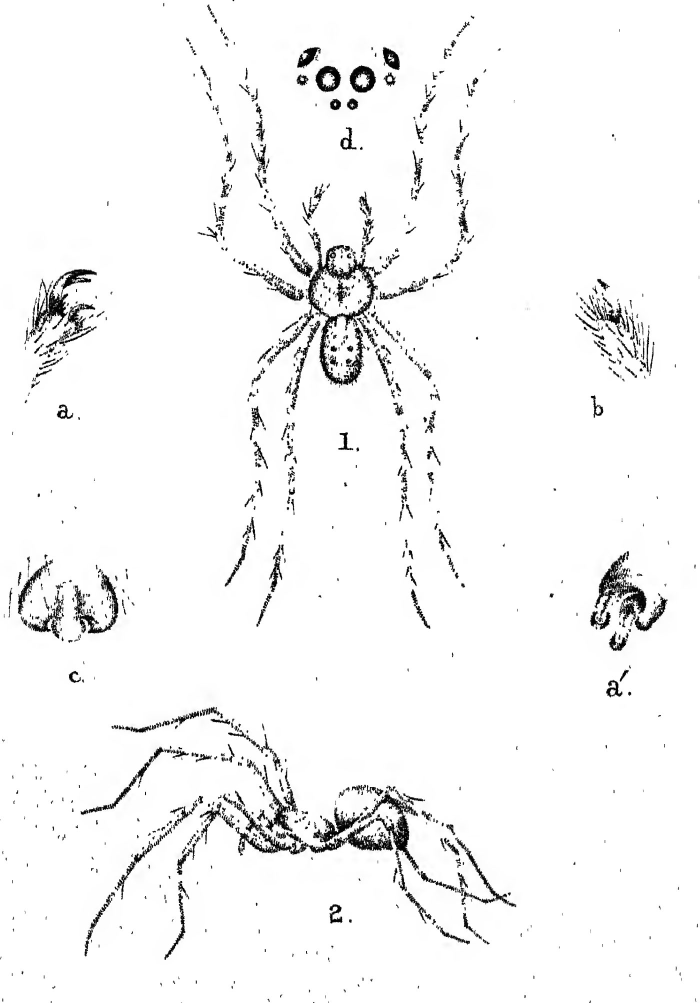
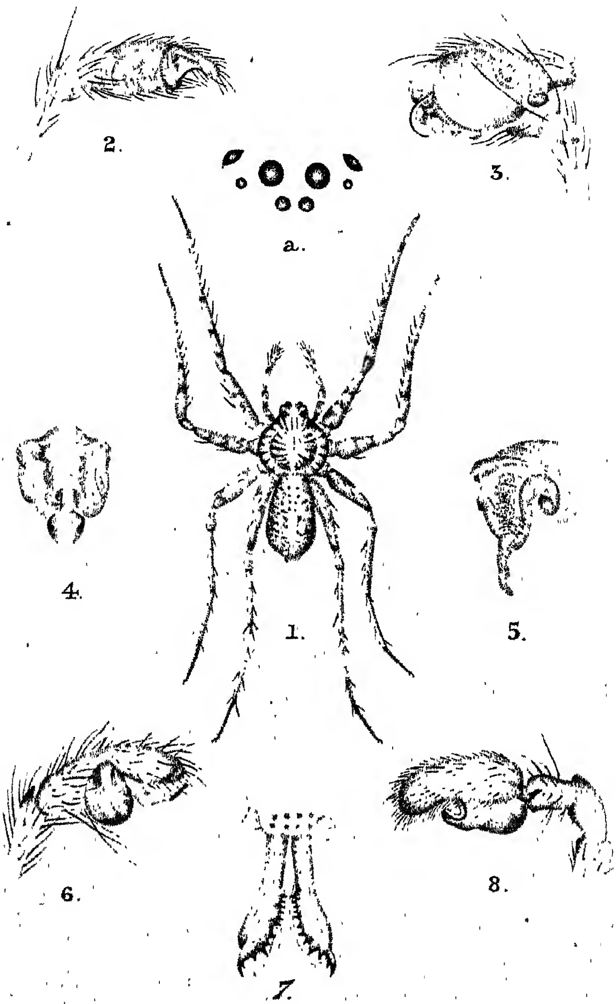
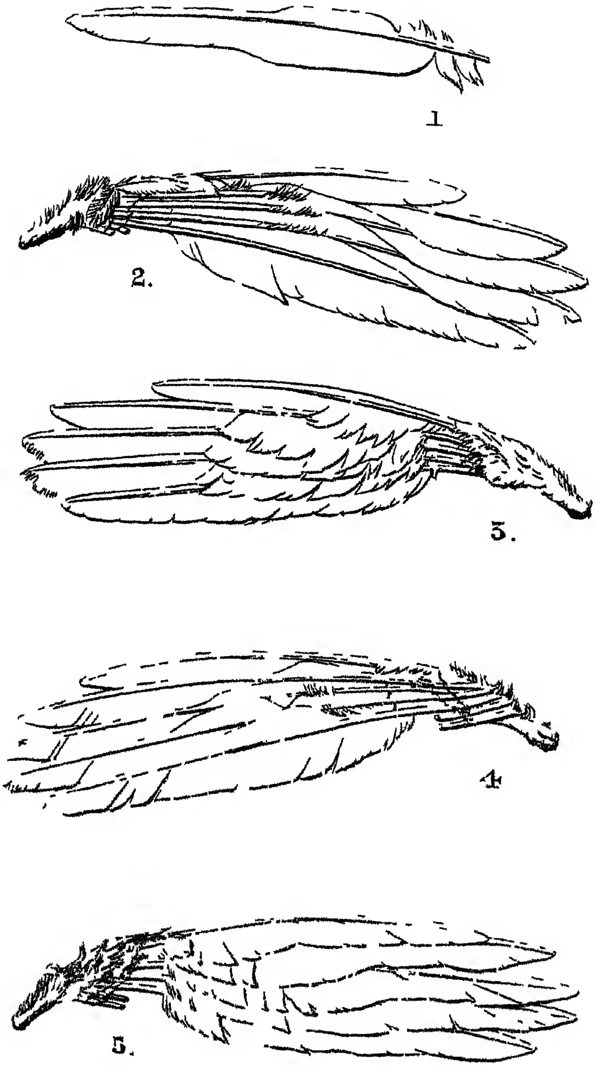


A.T.U. delt. JENOLAN CAVE SPIDERS. C.H.P. lith.



A.T.U. delt. NEW ZEALAND SPIDERS. C.H.P. lith.



To illustrate Paper by T W Kirk   C.A.P. lith.

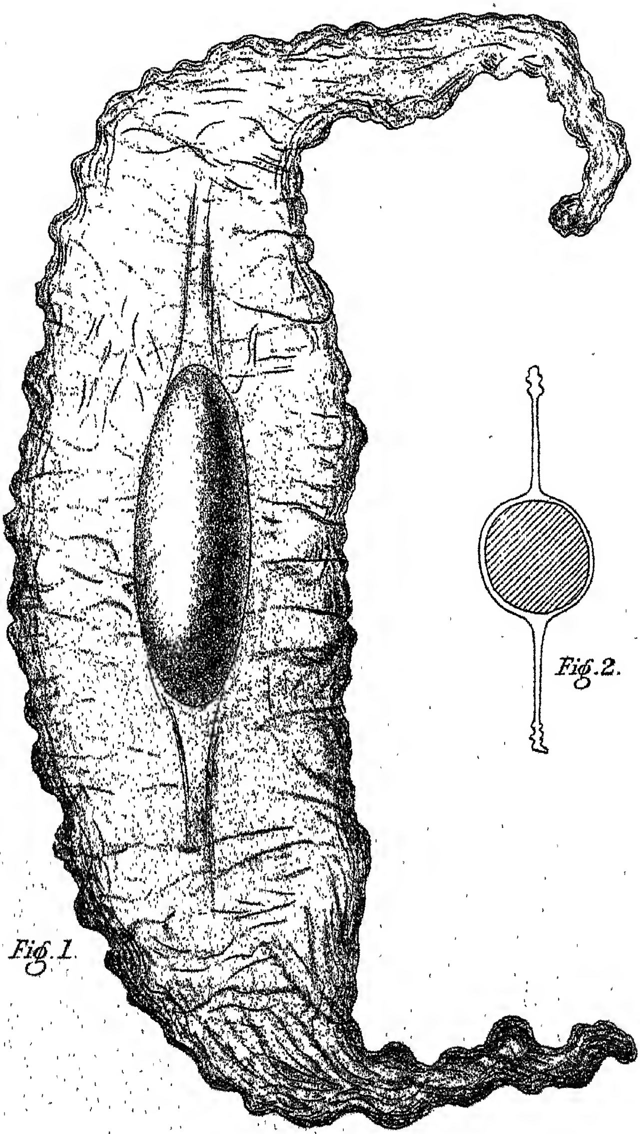
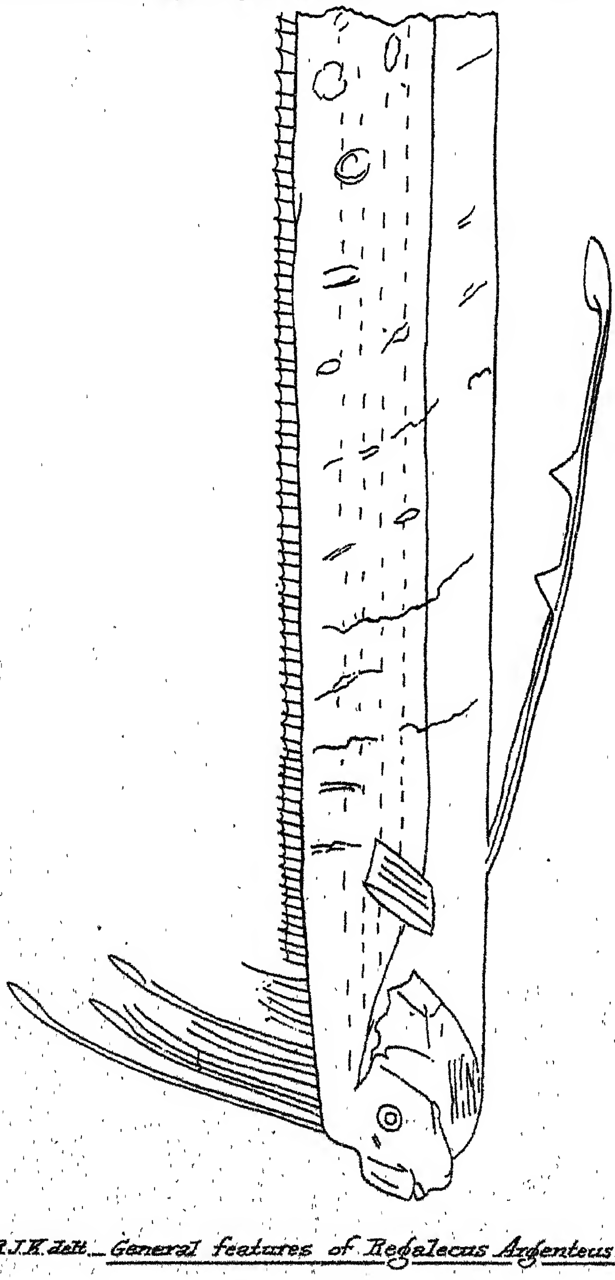


Fig. 1.

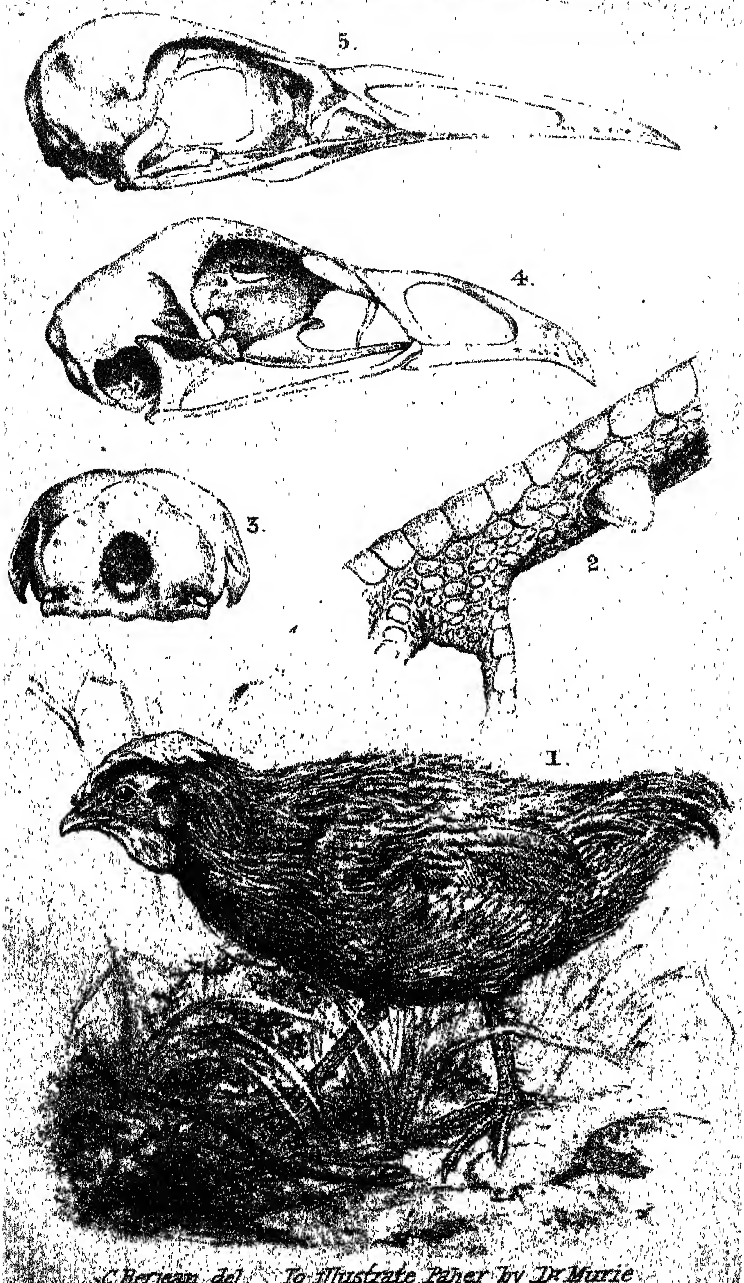
Fig. 2.

UTERINE EGG OF MUSTELUS ANTARCTICUS.

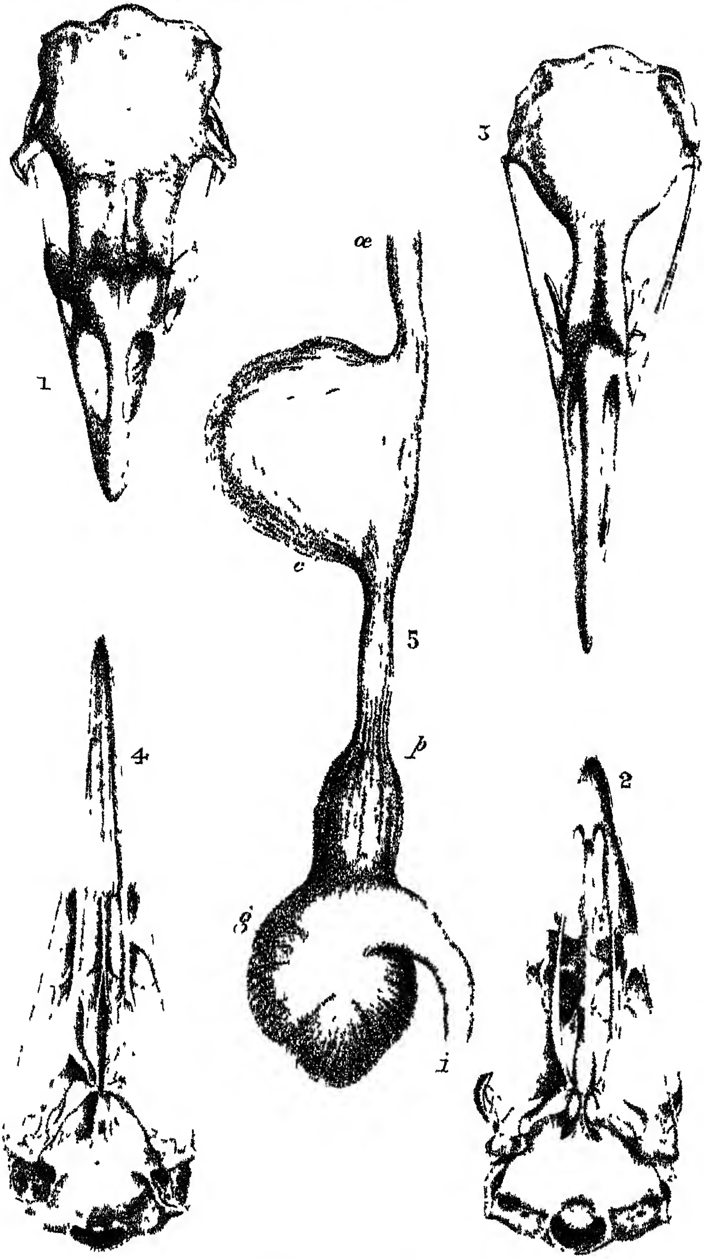
T. J. P. ad nat. delt. CHP lith.



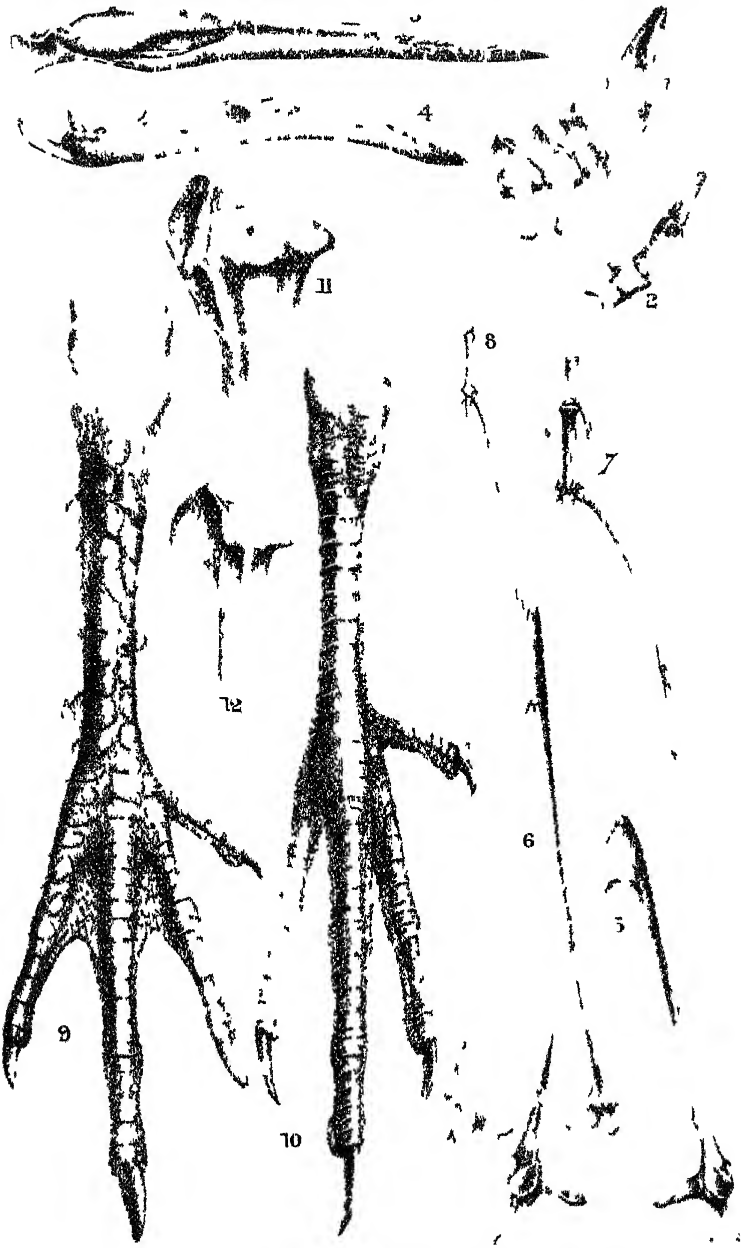
R.J.K. delt. _ General features of Regalecus Argenteus _ C.P. lith.



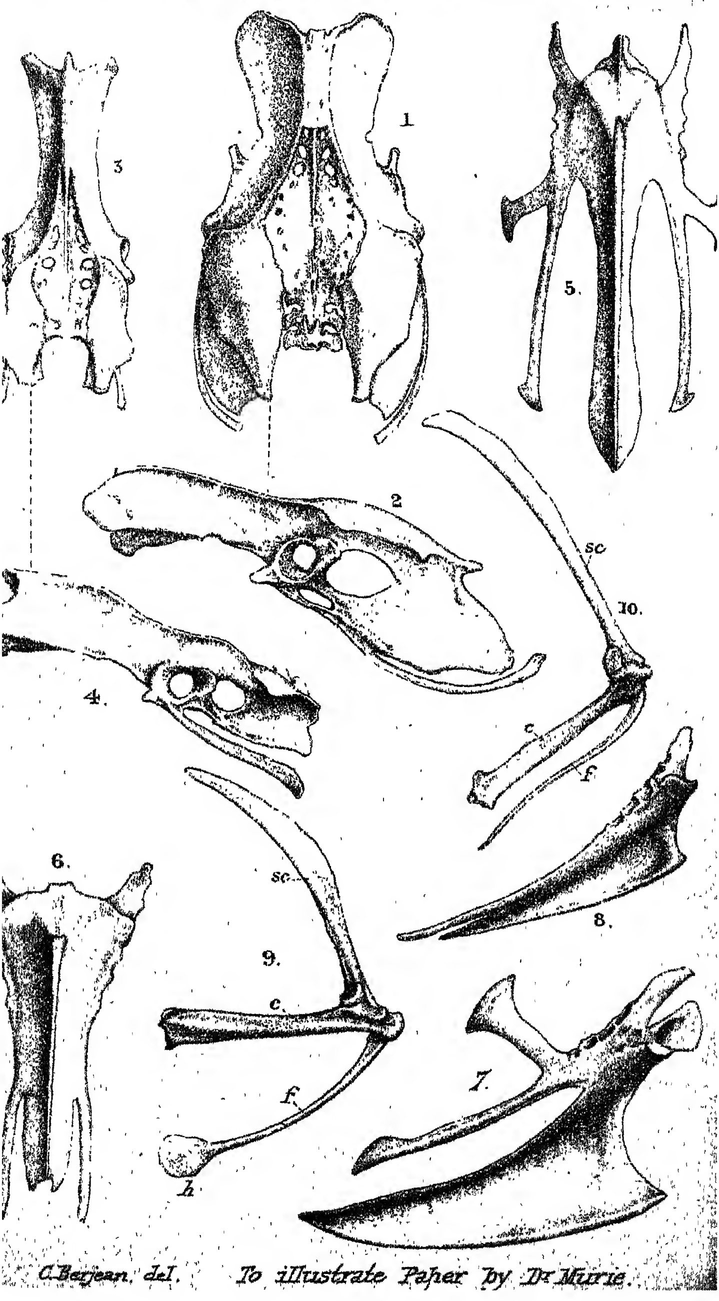
C. Berjeau. del. To illustrate Paper by Dr Murie



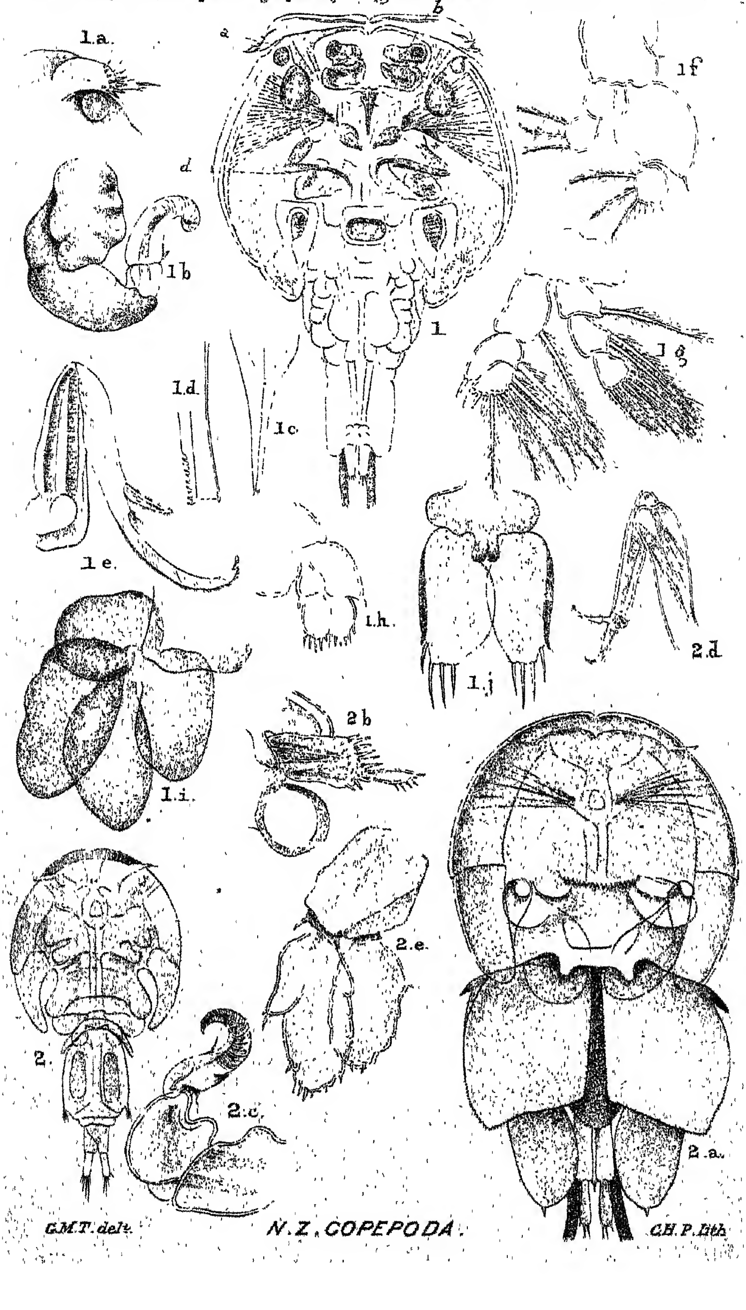
C Berjean del *To illustrate Paper by Dr Murie.*



C. Berjeau del.   To illustrate Paper by Dr Murie



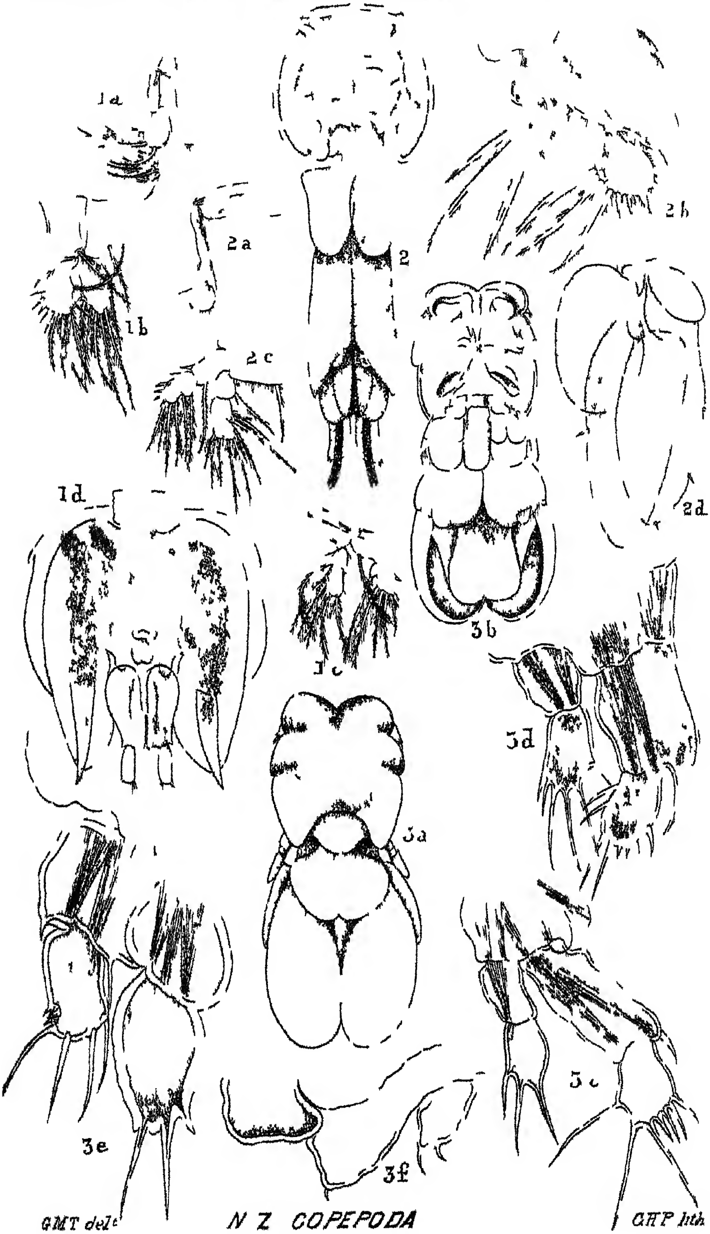
C. Berjeau. del. To illustrate Paper by Dr Murie.



G.M.T. delt.

N.Z. COPEPODA.

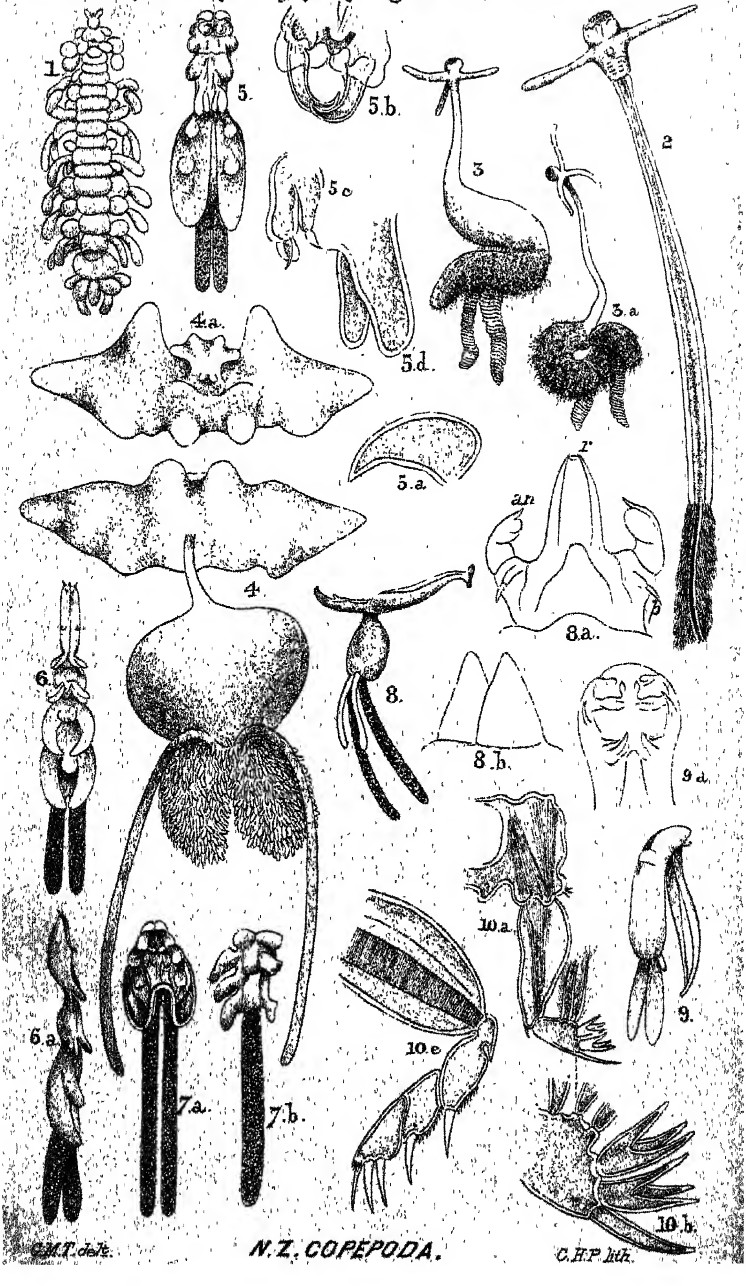
G.H.P. lith.



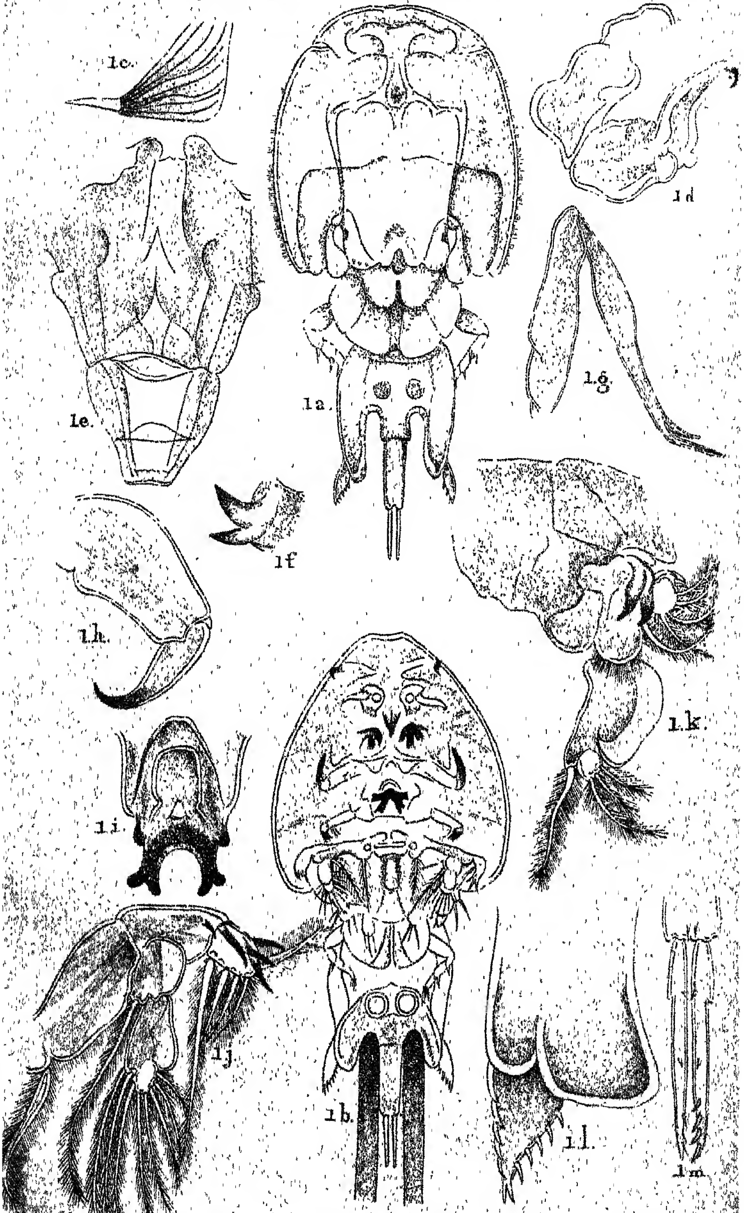
GMT delt   N Z COPEPODA   GHP lith

N Z COPEPODA

G M T del



G.M.T. del.t. N.Z. COPEPODA. C.H.P. lith.



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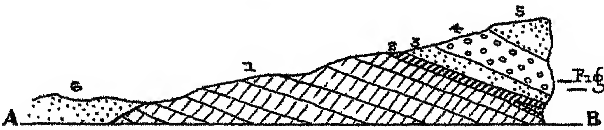


Fig 1.

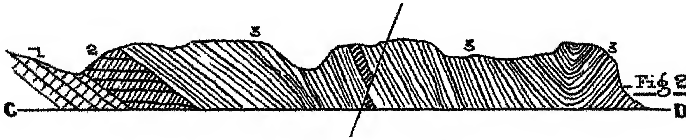


Fig 2.

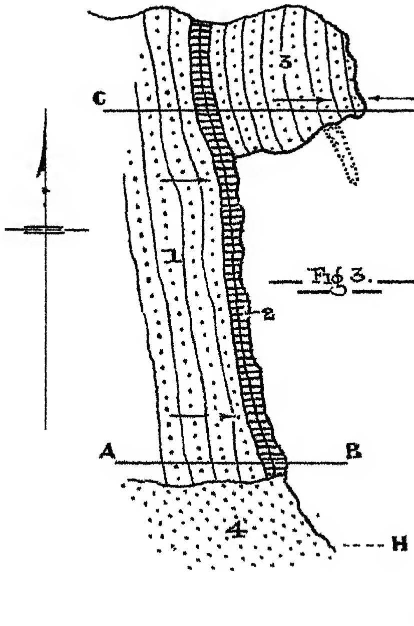


Fig 3.

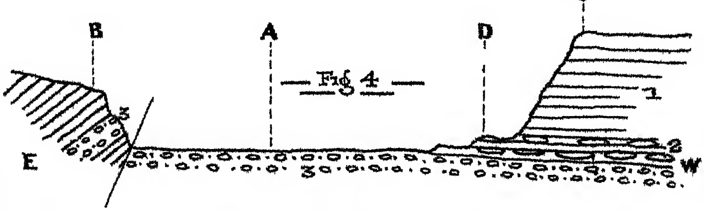
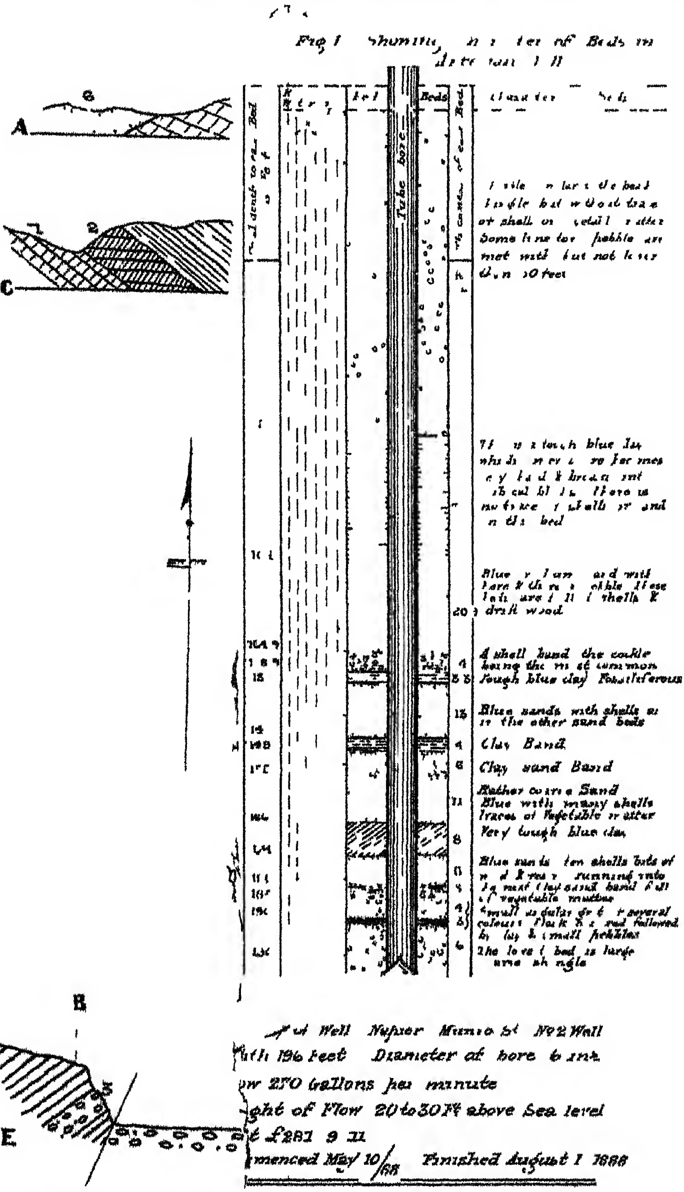
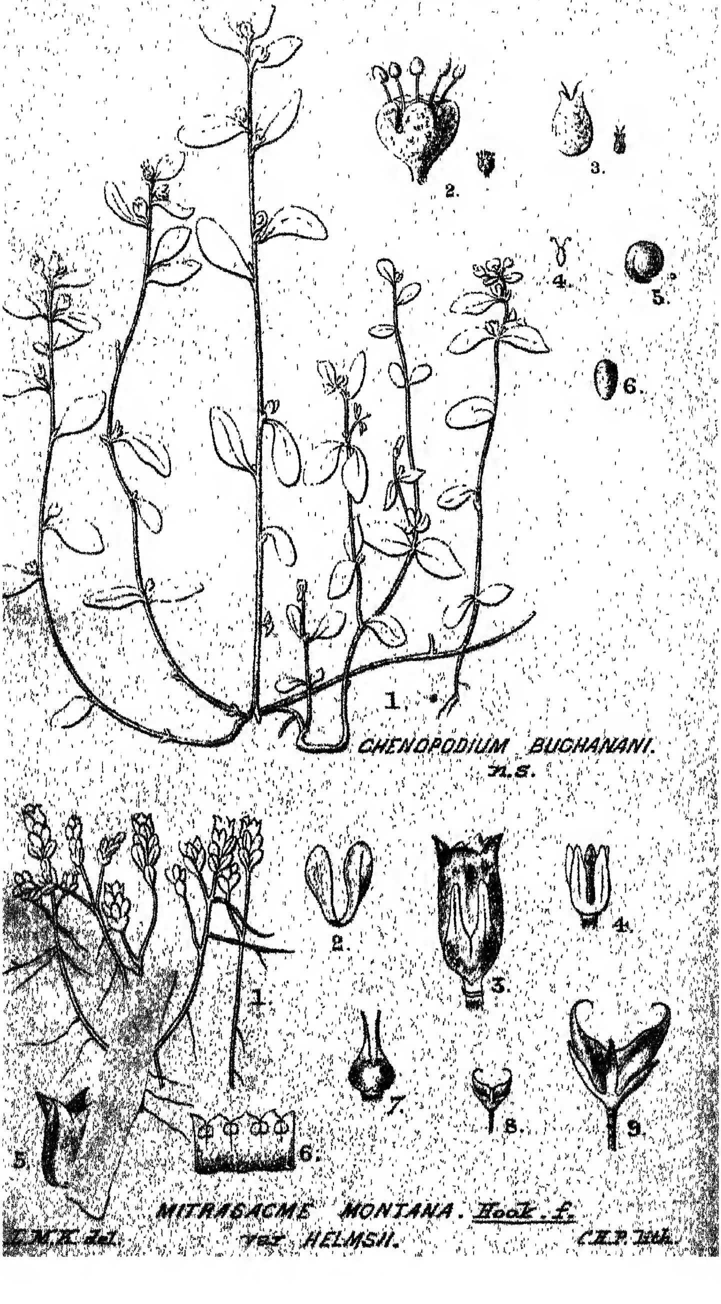


Fig 4.

J. P. delt. — To illustrate Paper by J. Park — C. H. P. Lith.



J T delt — To illustrate Paper by H Hill



CHENOPODIUM BUCHANANI. n.s.

MITRASACME MONTANA. Hook. f.
var HELMSII.

T.M.K. del. C.H.P. lith.